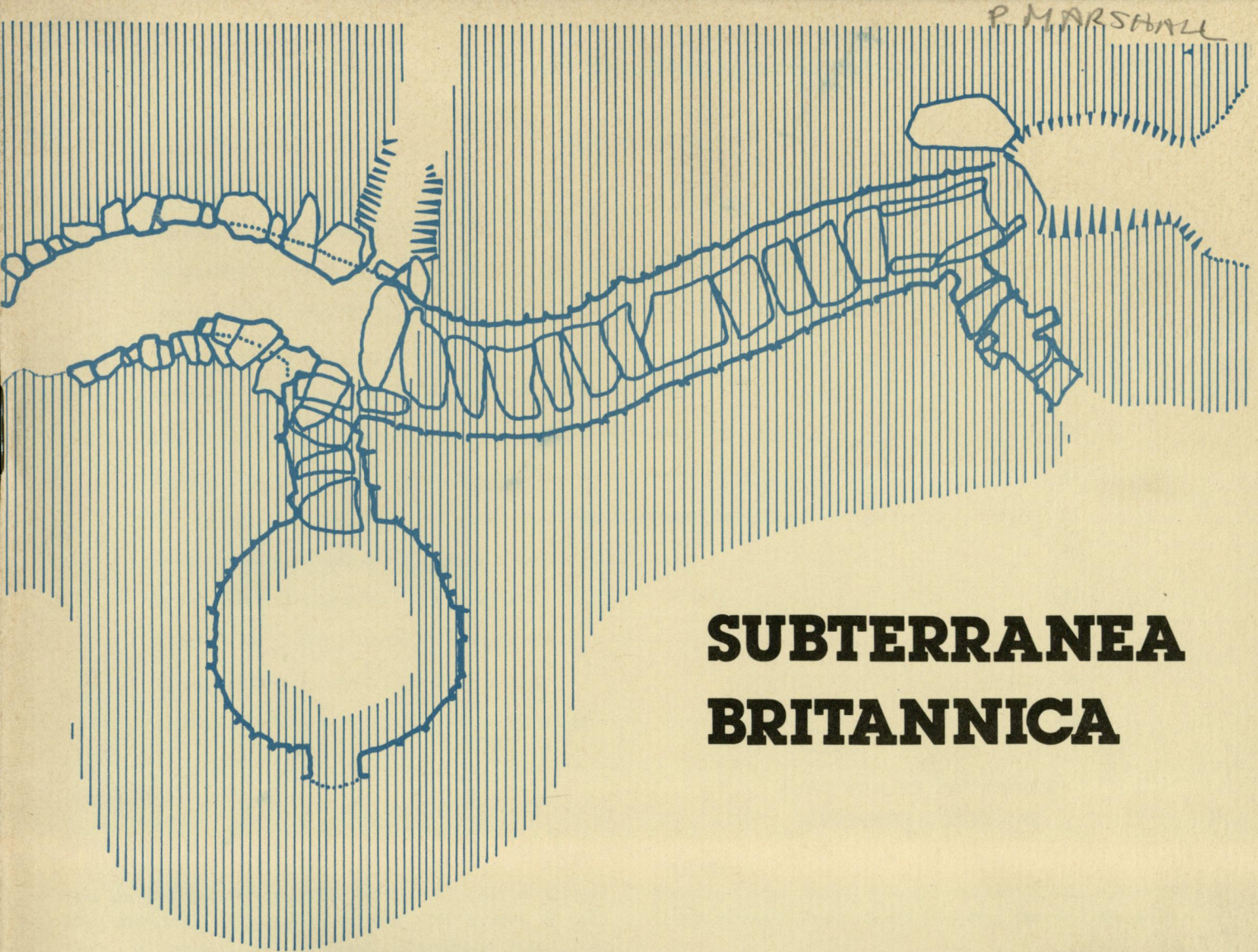
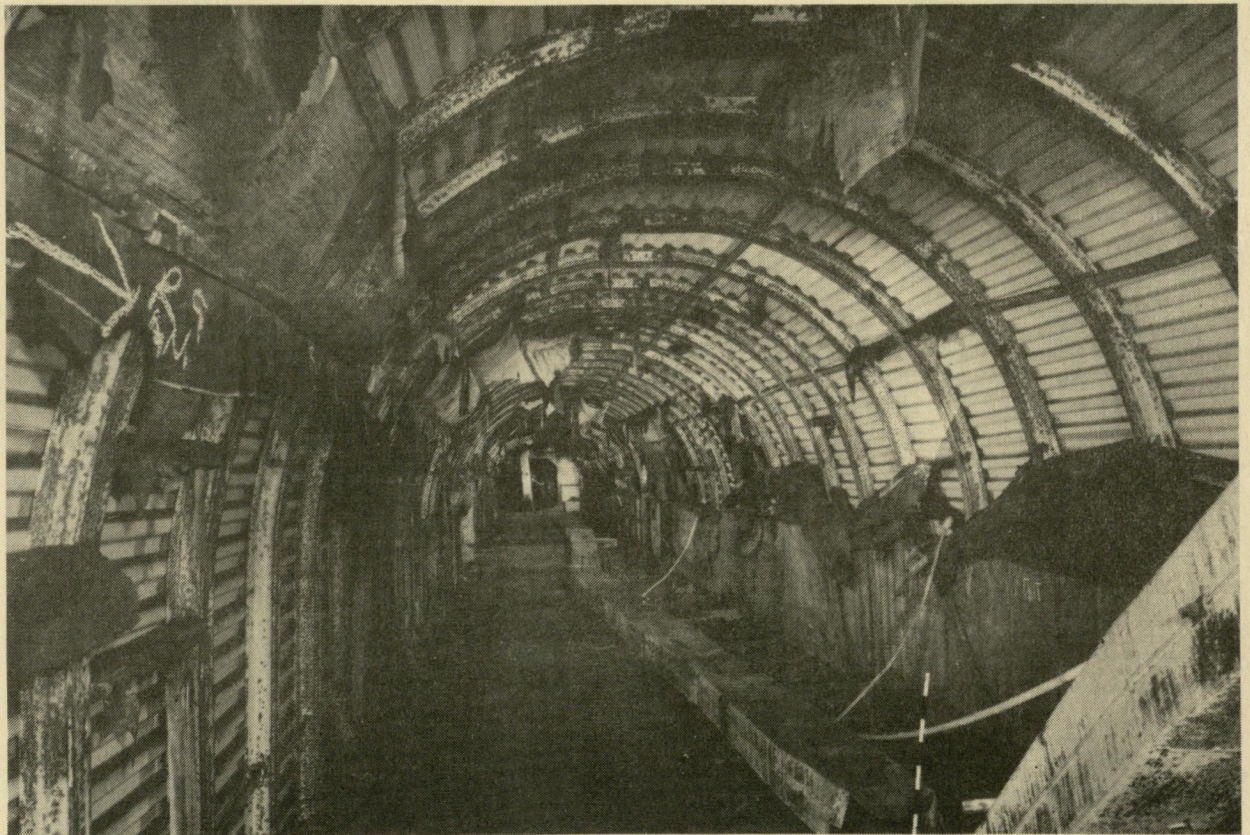


P. MARSHALL



SUBTERRANEA BRITANNICA



Bulletin No. 24

THE BULLETIN OF SUBTERRANEA BRITANNICA

No 24 - January 1988

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EDITORIAL

Sylvia Beamon

How do you describe yourself or your interest to others? With difficulty, I presume. "Well, I'm a sort of pot-holer, a spelaeologist". Vague expressions assail your listener so you try again: "I'm interested in, and study, man-made, man-used underground structures". The term spelaeology has perhaps been the closest except it means specifically the study of caves, meaning natural ones. Several years ago, when travelling to France on one occasion, I was in the process of going through customs at the airport clutching hand luggage with helmet plus batteries, and there was no problem whatsoever. The officer whisked up my haversack, raised it aloft and cried out loud, "Archeologue, speleologue", and walked me through. No questions of "What do you do exactly?" etc. It felt quite normal. I decided to call myself "an archaeological spelaeologist" thinking the phrase described the activity - alas few people understand the latter word anyway.

The French have now come up with a new name for us - "Subtterrannistes". Personally, I think this is a great improvement, and perhaps we should adopt it too. The Belgians have gone one better - delegates were greeted at Reves, near Charleroi (10-14 July) by a large banner proclaiming "SOBERES CONGRES DE SUBTERRANEOLOGIE" (congratulations to them on their well-organised first International Conference).

Many thanks to those members who have written to congratulate us on the new format of the Bulletin. We have had our teething troubles. This edition has a strong continental bias and illustrates the need for comparative material.

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EXETER'S HISTORIC UNDERGROUND PASSAGES, DEVON

Several members of the Society enjoyed a visit to underground sites in the Exeter area during the Study Weekend, 23rd-26th June 1987. The booklet reproduced below, with permission of the Exeter Official Publicity and Information Bureau, is now out of print; it is undated and the authorship is unknown, but it was probably published in the early 1950s.

The story of the underground passages, at least of those in the eastern part of the City, is the story of Exeter's earliest water supply. In order to understand this story, a short description of the topography must be given. The ancient walled city lies on a spur of land which slopes down on all sides except the E where it is connected by a ridge to the higher lands lying to the NE. Sidwell Street follows this high ridge, and the line is continued down Catherine Street, which is considered by many authorities to have been the original main street of Exeter. The modern Sidwell Street leaves this line near the junction with Paris Street to join up with the newer line of High Street.

The site of Exeter is well watered. A considerable number of wells are still in existence in the city itself, and from mediaeval times up to the last century these served the different houses. Some of the best sources, however, lie in the upper Longbrook Valley and it is with the supply of water from these springs we have to deal.

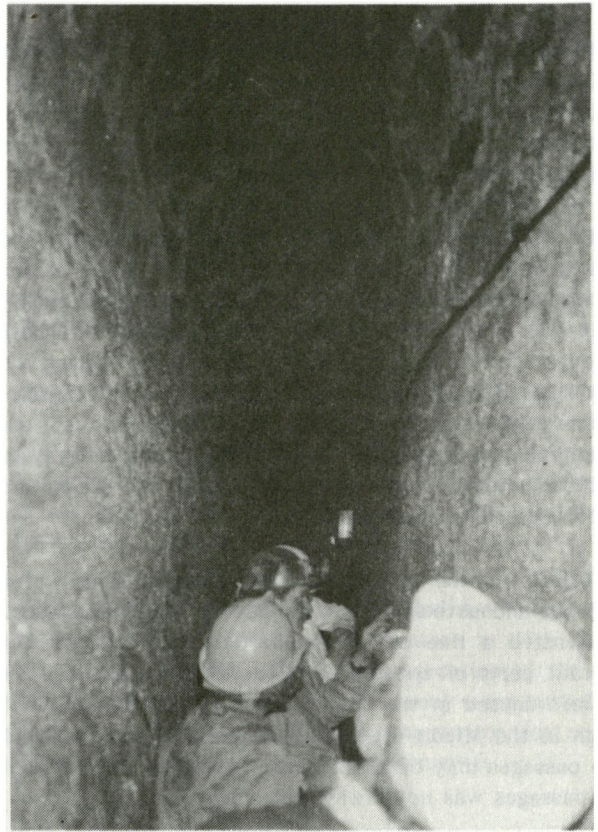
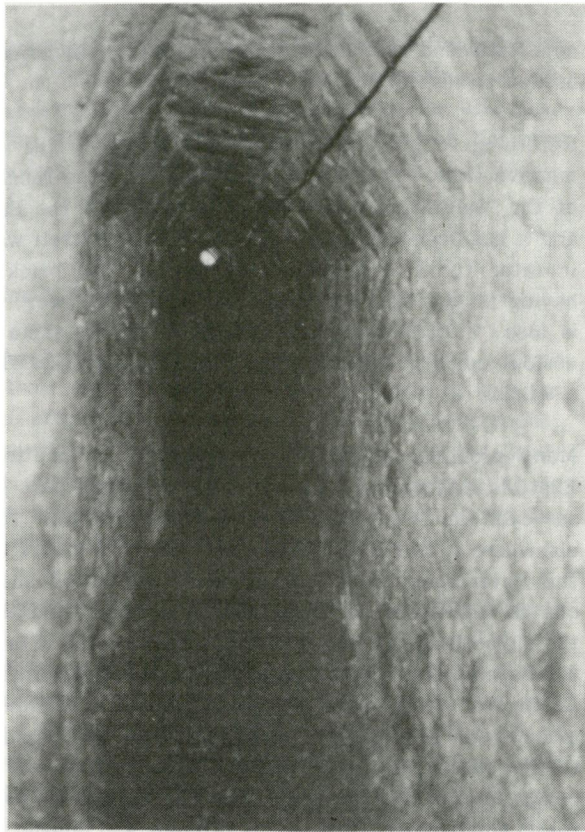
The most famous is that of Sidwell Street, the *Fons Sanctae Sativolae*, as it is called in the ancient documents. The story of the life of the Saint has been preserved in the Cathedral for 500 years but is clearly based on earlier material. It tells how a rich noble, by name Bonia, a Christian, who lived outside the City of Exeter, had one son and four daughters. The eldest daughter, Sativola, was a Christian renowned for her "beauty of form and blamelessness of behaviour". After the death of her mother she incurred the enmity of her step-mother who was a pagan. This step-mother induced the serfs who were mowing the meadows to the E of the City to set upon Sativola as she came down to bring them their food. Thus she was slain with a scythe and where her head fell, there gushed out a "most sparkling spring". The date of her martyrdom is said to be A.D. 740. Some students would see in this story a yet much earlier legend connected with the corn spirit and in all probability the fame of this spring dates back to very early times, even before the coming of the Romans. It is sufficient, however, for our purpose to show that it must have been a well-famed spring in very early times.

The earliest known document containing a reference to the passages dates from 1226. In it the Dean and Chapter grant a third part of the water which was being brought from St Sidwell's Well to St Nicholas Priory. The water at this time flowed by gravity from the Well into the City, portions of the old stone channel being found in certain lengths of the passages.

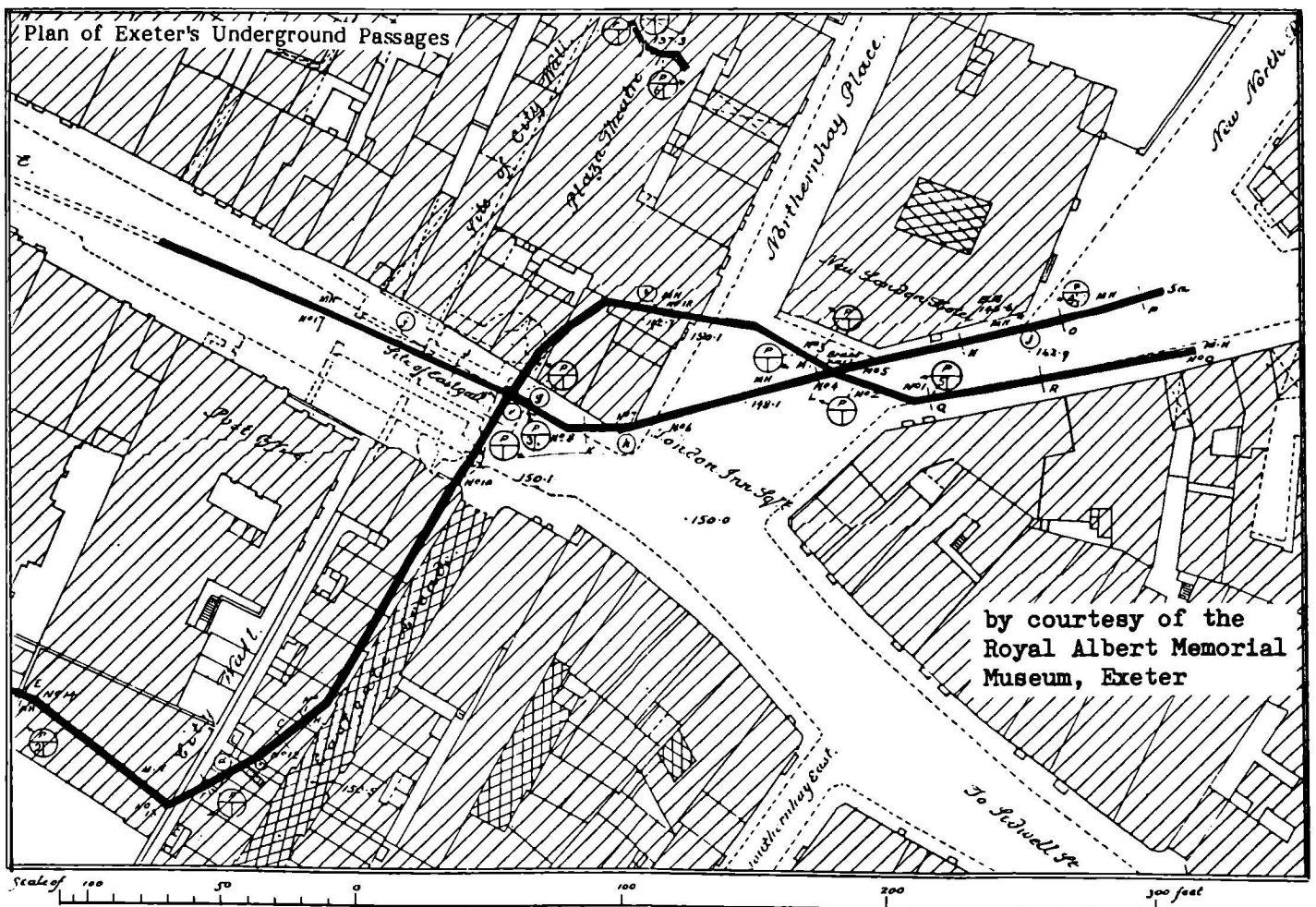
If the city was so well supplied with water by its own wells, the question at once arises why, at such an early date, was such an elaborate conduit from outside the city necessary and who originally made it. Perhaps the answer to these questions is to be found in the Roman Baths whose foundations lie beneath the garden of the Deanery. In Roman times a larger supply of water per head of population of Exeter would be wanted than at any time almost up to the present day. The older portion of the passages follows the contour line from St Sidwell's Well until it reaches the line of the old ridgeway near the site of the Eastgate. It then bends sharply to enter the city at a point which would correspond to the supposed site of the earlier gate. From this point the line of the passages leads down the old main street, almost directly towards the site of the Roman Baths. In addition to this, the actual fall from St Sidwell's Well to the Roman Bath lies within the limits assigned by Vitruvius for supplying water by gravity. The bend in the passage line under the Eastgate is consistent with good engineering practice, i.e. of making the shortest possible tunnel in order to carry the fall-level through the ridge. Although we cannot prove the Roman origin of the passages, we can safely say that all the evidence points to it.

If this supposition is correct, the supply would doubtless have been used by the Saxon Monastery occupying the site where the Bishop's Palace now stands and would have been taken over by the Cathedral Authorities when the See was transferred from Crediton to Exeter in 1046. As has already been stated, we have documentary evidence to prove that two hundred years later a third share in the supply from this source was granted to St Nicholas Priory.

From this date the story of the passages is clear. In 1347 the Cathedral Records show that a considerable sum was spent by the Dean and Chapter in digging a new aqueduct and in laying lead pipes. Recent work has shown that the supply then tapped was a spring in Headwell Mead (near Lion's Holt) and that by using a pipe instead of an un-piped culvert, this supply was brought up Longbrook Street, the pipes being laid along the old culvert as soon as it was reached. It is assumed that the original passage between this point and St Sidwell's Well would be disused. About a hundred years later in 1436 we learn that, owing to a dispute between the Dean and Chapter and the City Authorities, the latter decided to provide their own supply making use of a source quite close to that belonging to the Dean and Chapter. A new passage was constructed parallel to the more recent portion built by the Cathedral Authorities. This passage strikes the old



Views of Exeter's Underground Passages, taken on the 1987 Study Weekend in the Exeter Area.
Both photographs show the narrowness of the tunnels and the semi-arched roof structure
(photographs by Sylvia P. Beamon)



disused passage between St Sidwell's Well and the line of the Cathedral supply. The City made use of this old portion as far as the part then in use. From this point a new passage was cut directly through the Eastgate and down the High Street to the Great Conduit at Carfax.

This Conduit was in use until 1770 and was then removed to South Street, but even as late as 1833 the Exeter Water Company agreed not to interfere with this source of supply and it was not until 1877 that the Corporation finally took over the water supply to the City. In 1859 when the South Western Railway Company was constructed, the well-house of the Dean and Chapter was destroyed and the Company had to arrange for a continuance of the supply to the Close and it was only in 1904 that the Dean and Chapter ceased to maintain it.

This briefly is the history of the passages as a water supply but undoubtedly they were put to many other uses. So extensive a line of communications between various important parts of the city was far too valuable to have been left unused in the troubled times that Exeter went through in the Middle Ages. The head of a halbert found in the passages may be an indication that the way through these passages was not always left unguarded.

The visitor will find much of interest when passing along. In some places the passage is cut through the solid rock while at others there are different types of masonry and all along the differences in the roof should be noticed. From time to time the level of the floor has been considerably altered, in some cases being raised by filling with ashes when the passage became flooded in recent times. In other places the roof is 14 feet [4 m] above the present floor level, an indication of a considerable lowering at some date.

Undoubtedly one of the most interesting spots is a large chamber which stands on the W side of the foundations of the Eastgate. It can be seen that foundations of the western bastion have been built over the earlier tunnel which here is passing under the high ridge, while the newer passage of the City supply enters the City through the new gate. In the passage from this chamber are some of the earliest stretches of masonry. At one time a lead pipe of very old manufacture (possibly 1347 when they were first laid in these Passages) ran for a considerable length to the South from this chamber. Its great age was evidenced by the fact that it was formed by beating strips of lead around a cylinder, the edges being burnt on the top. A section can be seen in the entrance hall of the Royal Albert Memorial Museum in Queen Street. In this part of the passage the manholes or dipping holes in the roof should be noticed. It is probable that these holes were used for tapping the supply before it was piped. There is also a curious flight of steps leading down from a point in the Eastgate Arcade, just outside the city wall and near the position of the earlier gate. Do these steps represent a place where the tired traveller who arrived outside the gates after they had been shut for the night,

could descend and draw water to refresh his beasts of burden or his cattle?

Returning to the Chamber, we see on the S side another massive wall. This may have belonged to the foundations of the "Salutation Inn" which was built into the Eastgate and it has been suggested that the Chamber itself was used in later times as a cellar to the Inn, the brick bench having at one time supported the barrels of beer. There is also, a little further on to the E on the same side a curious opening high up in the passage. Whether this was a window or a door is not certain.

Many problems remain to be solved in connection with Exeter's Underground Passages, both in the part already surveyed and in other parts which are known to exist elsewhere in the city, but the visitor who wanders through this interesting part will realise that he or she is in one of the oldest constructions in Exeter, and that, if the supposition of a Roman origin is correct, it is nearly 2,000 years since part were cut by the Roman Engineers. During all these years almost right up to the present, citizens of Exeter have passed through the passages on their lawful and unlawful occasions. Exeter is to be congratulated that at least a portion of them have been saved and opened again for its citizens and guests, before they have gone the way of so many other relics of the past

Mention perhaps should be made of another type of passage under the Plaza Theatre (destroyed during the air raids of 1942).

We read in a contemporary description of the siege of Exeter in 1136 that Stephen the King, who was besieging Baldwin in the Castle, summoned "those who had experience in cutting tunnels" to "explore the entrails of the earth with a view to destroying the wall".

It is not improbable that in these roughly hewn passages we have a visible record of the works of these miners 800 years ago.

The advantage of secret underground communication between various points in the city are so obvious that it can be assumed that they were so used in the troublous times.

To sum up:- On the present line used by visitors the entry is made into the passage of 1436 belonging to the City. At the Bend, it links up with the earliest passage from St Sidwell's Well and one passes through this passage to where the Cathedral second supply enters. Here we leave the line of the Cathedral supply and again follow the City line until we reach the chamber, where we see on the right the foundations of the Mediaeval East Gate and the line of the City supply carrying straight on down High Street. Notice that the line of the Cathedral supply crosses the City line here, on the right passing under the masonry of the East Gate, thus dating it to the time before this Gate was built and on the left continuing down the Eastgate to turn down Catherine Street.

This description is based on a Report on the Underground Passages of Exeter published in the Proceedings of the Devon Archaeological Exploration Society for the year 1932. The authors wish to acknowledge the debt they owe to the Society for the permission, that has been freely granted to make use of this Report.

Notes added by Deryck Laming:

The Underground Passages undoubtedly show only a small part of their original extent, and the section on show as a tourist attraction (Tuesday and Saturday afternoons, admission 40p) is even less. Fortunately, on the Study Weekend, members were given permission to enter those parts not normally accessible; they were also shown the location of the passages from the surface.

Rebuilding after bomb damage, and the extensive redevelopment of this area after the war, have removed almost every building mentioned in the pamphlet reproduced above; the underground passages, indeed, seem to be the only unchanged feature! Even these are now being affected, as construction of a new office/shopping complex is now under way on London Inn Square at the NE end of High Street,

EXCAVATIONS BENEATH TOWNS IN BELGIUM

Guy de Block

We are indebted to Owen Ward for his translation of this article.

For several years now spelaeologists (often with archaeological advice) have been turning their attention to the problems of discovering evidence of earlier times in artificial underground environments (as opposed to caves and other natural cavities underground).

They have been clearing subterranean passages in castles, surveying cellars and long disused watercourses, excavating the cellars and other features of fortified farms, emptying and examining wells and reservoirs which have been discovered by chance, and so on.

"L'Equipe Speleo" of Brussels, for example, have been undertaking the following excavations:

May 1976-January 1977 - excavation of a well in the Citadelle at Namur.

Namur is one of Belgium's major towns, and is situated at the confluence of the Meuse and the Sambre. The Citadelle is a rocky fortress which has always provided an admirable defensive strategic post overlooking the town. It was a Neolithic camp, a castle in Merovingian and Carolingian times, and a military fortress from the 17th Century onwards. A well, 52 m deep when it was first dug,

but this will incorporate a new entrance to the passages complete with an "interpretation room" in the basement. At present the entrance to the passages lies on the line of the City Wall at Eastgate, where it joins the pedestrian street of Princesshay which runs parallel to High Street. The passages run beneath both streets; in the other direction, one runs beneath the end of High Street to New North Road, and another ends in a locked grating outside the Threepenny Bit public house in Longbrook Street, behind Debenhams store.

These are the upstream portions of the two systems, one to the City and the other to the Cathedral, which received their supplies from sites in Well Street near the top of Sidwell Street. The gathering chamber for the Cathedral well was intersected when the cutting for the London and South Western Railway was excavated close by.

The Plaza Theatre, where the siege tunnel was found by the City Wall was located behind Boots' store in High Street and is now a car park. Possibly construction of the new building at London Inn Square will reveal more tunnels of this system, though inspection by the writer has so far revealed only brick arches of old basements.

was the only source of drinking water for the occupants of the site. It has a diameter of 3 m and was cut by hand with picks in hard, Carboniferous sandstone.

In 1976 the local authority gave permission for the well to be completely dug out. Water was found at a depth of 44 m and old disused pumping equipment (iron shafting and ladders) occupied the entire depth of the well. A total weight of many tons of metal was hanging on by a few remaining brackets!

So the first job was to remove all the debris from what remained of the platforms, which had accumulated on them over the centuries, and to take a blow-torch to cut away the pieces of iron which were hanging dangerously in space, before we could reach the surface of the stagnant water 44 m down from the mouth of the well.

Thus far all the techniques of the spelaeologist had been called upon to make progress in safety. But in view of the significance and the size of the task still remaining, it was decided to make use of more appropriate technical resources. A large commercial undertaking agreed to lend us some of their best equipment (a powerful compressor and pumps) so that we could carry on our exploration.

From the well, 190 m³ of water and 42 m³ of spoil were removed; remains of all kinds from all ages were discovered - from munitions dating from the two world wars back to cannon balls.

Work had to be halted for lack of adequate equipment when the company concerned had to take their compressor and pumps back for their own use. The work had reached a depth of 50 m out of the probable 52 m. Exploratory work can only be continued with the help of more powerful and dependable technical resources, which the Namur authorities have been asked to provide.

1977-1979: Exploration of an underground stream at St Gilles-lez-Bruxelles

At the request of the local authorities, a survey of an underground stream was carried out. It runs beneath Jacques Franck Park and the former Mint. In order to complete the operation some thick steel bars, intended to prevent thieves from penetrating the Mint, had to be cut away with an oxy-acetylene burner. The exploration showed that the stream ran towards the Porte de Hal. In this way the history of one of the numerous streams bringing drinking water into the City in past centuries was completed. As a parallel exercise, the survey contributed towards preliminary studies for the construction of modern buildings on the site of the former Mint.

Since 1978: Excavation of the wells at the Abbey of Mont Cesar (Keisersburg) at Leuven

These excavations were undertaken with some apprehension

in the knowledge that in 1940 an unexploded shell had been tipped into one of them!

When they were first dug the wells must have been some 32 m deep; when work started in 1978, they were almost 28 m in depth. Their origin is linked to the foundation of a fortified settlement in the year 1000 A.D. Since that date successive Lords have aimed to improve this rocky spur; a fortified castle was developed there from the 12th Century onwards.

Excavations in the first well yielded a variety of objects: coins, iron chains, builders' rubbish etc. In October 1981 the unexploded shell was found and later taken away by the Army's bomb squad ("Service de Deminage"). It was a German 150 calibre shell weighing 43 kg. Other war material was brought up to the surface, notably a hand grenade, some cartridges and an anti-aircraft shell, etc., which lent a somewhat uneasy atmosphere to the excavation!

From this site too the Brussels "L'Equipe Speleo" is hoping to bring to light evidence from times past and to learn more about the occupants of Mont Cesar and of its history.

Results of research are published regularly in SUB-TERRA, the publication of the Society. The Brussels "L'Equipe Speleo" is a founder member of SOBERES (The Belgian Society for Underground Study and Research), a group which includes amateurs and professional specialists in mediaeval archaeology.

EXCAVATIONS AT PFAFFENSCHLAG, MORAVIA, CZECHOSLOVAKIA

Karl Schwarzfischer

A description of a deserted mediaeval village in Czechoslovakia and its importance for the study of its underground galleries. This paper was first read by the author at the Societe Francaise d'Etude de Souterrains XI International Symposium in July 1981 in Villeneuve-sur-Lot.

Again, thanks are due to Owen Ward for his translation of this article.

An excavation of Pfaffenschlag was carried out by the historical and archaeological section of the Moravian Museum, with the collaboration of palaeobotanists, between 1960 and 1971 and was crowned with complete success. It revealed a remarkable amount of information concerning social conditions of the mediaeval peasants and, above all, produced scientifically confirmed information about underground galleries.

The following notes are drawn from the final report by Vladimir Nekuda.

The deserted village of Pfaffenschlag was discovered in a large area of forest 575 m above sea-level. The site has

always been surrounded by woodland, once being part of the virgin forest. We have to distinguish between two periods of occupation:

1. The early settlement
2. The mediaeval village

The early settlement, probably Slav in origin, can be dated to the 11th and 12th centuries. Archaeologists have identified seven dwellings, each covering an area of about 24 m² (about 260 square feet), and partially hollowed out of the surface on which they were built. In the immediate proximity of these hut-dwellings, seven silos had been dug in the soil and the walls of these had apparently been

fired. The silos had been specifically dug to conserve grain, which could have been kept dry in either wooden or earthenware containers, traces of both having been discovered. Excavation of the early settlement revealed no underground workings of any kind. This settlement was abandoned because of a fire during the second half of the 12th century.

The mediaeval village formed part of an extensive colony, probably Austrian, founded between 1280 and 1300. As mentioned, the area was wooded and as a result it was a struggle to cultivate it. Experts have brought to light sixteen houses and accompanying structures. A quick look at the plan shows how the rectangular foundations of the houses follow the line of a stream for 140 m. They are of local stone, bonded with clay. The walls must have been of wood and the roofs of thatch. On the plan can be made out ten houses of three sections each, five houses of two sections, and a mill. The ten tripartite houses and one of the double houses made up eleven farms; the rest were occupied by smallholders and journeymen. The author established that the village was finally abandoned between 1423 and 1437 because of a major fire, which occurred therefore during the Hussite wars. The dating of the village from its foundation to its destruction can be reliably based on archaeological evidence and scientific analysis.

When Pfaffenschlag was excavated, small cellars belonging to five of the houses were discovered dug into decomposed stone. Access to each was by a short passageway directly from the house. Their small size suggests that they were stores for keeping cool certain foodstuffs, such as milk. According to Vladimir Nekuda these cellars betray an urban influence, because they are unknown in rural contexts.

Two underground passages, described by the author as "Erdstalle", were uncovered beneath houses Nos 9 and 11, both of the tripartite type, with some apparent resemblance between the two passageways.

The tunnel beneath house No 9 measured 21 m in total length, 10 m of which was in a straight line, while the other 11 m twisted and turned. The height varied between 1.68 m and 1.80 m. The average depth* below ground was 2.34 m, but the ground is not level at that point and at one end drops by 1.37 m.

The tunnel beneath No 11 was 24 m long, of which 13 m formed the winding part and it was 1.52 m high. Its depth was the same as No 9. The width of both tunnels varied between 49 cm and 95 cm: there were in addition several niches set into the walls. In the tunnel beneath No 9 these niches were between 95 cm and 1.95 m in depth and 1.20 m high. The biggest of the niches had a seat in it. Other small niches had been cut, probably to take some form of lighting.

*Not stated, but this must be between the roof and the ground above (Owen Ward, translator).

It is most important to note that both tunnels lie within the ground plan of the buildings above.

Nekuda believed that there is no question of their having been underground refuges, given that the only access, which was inside the house, was not hidden, but was on the contrary fully visible; their location beneath the house would have put the occupants in danger. Archaeologists tell us that peasants would have taken refuge in the forest. The author interprets these two tunnels as places of safe keeping for essential belongings in case of fire. Nekuda observed finally that the tunnels were dug in the 13th Century and that they were in use until the village was finally abandoned at the beginning of the 15th Century.

To sum up, the excavations at Pfaffenschlag offer important information about the underground workings there, as follows:

1. The tunnels were built to the same plan as the houses, and therefore at the same time;
2. They were built by people who were colonising a settlement established by the church; "Pfaffenschlag" means an assart by priests. It is significant that most "Erdstalle" (souterrains) are found in the poor regions of Bavaria, and archaeologists make the same comments concerning the settlement of Pfaffenschlag;
3. It is a curious fact that, of the 16 houses, only two have underground workings;
4. The dimensions of the tunnels at Pfaffenschlag are greater than of those found in the Bavarian forest. In the author's opinion the larger size indicates a later development. The colonisation at Pfaffenschlag belongs to a period when the "Erdstalle" was going out of favour in Bavaria;
5. As for their interpretation, the author agrees with Vladimir Nekuda that the Pfaffenschlag tunnels were not designed as refuges, but not with his theory that they were built to keep essential objects safe in case of fire; the situation of finds argues against this view. In the mediaeval village were 11,321 pieces of pottery, 227 iron objects, 4 bronze objects and 19 stone objects were discovered, but the author can only point to one single find, a ploughshare, recovered from a tunnel. It must be borne in mind that Pfaffenschlag was reduced entirely to ashes during war time, when the inhabitants were obliged to keep constant watch for any sign of danger.

Editor's Footnote: As an outside observer, I would like to comment that, if these "Erdstalle" were used to protect valuable goods from fire, after a fire had raged the property presumably would have been removed when the area was cool enough - hence the lack of remaining artefacts within.

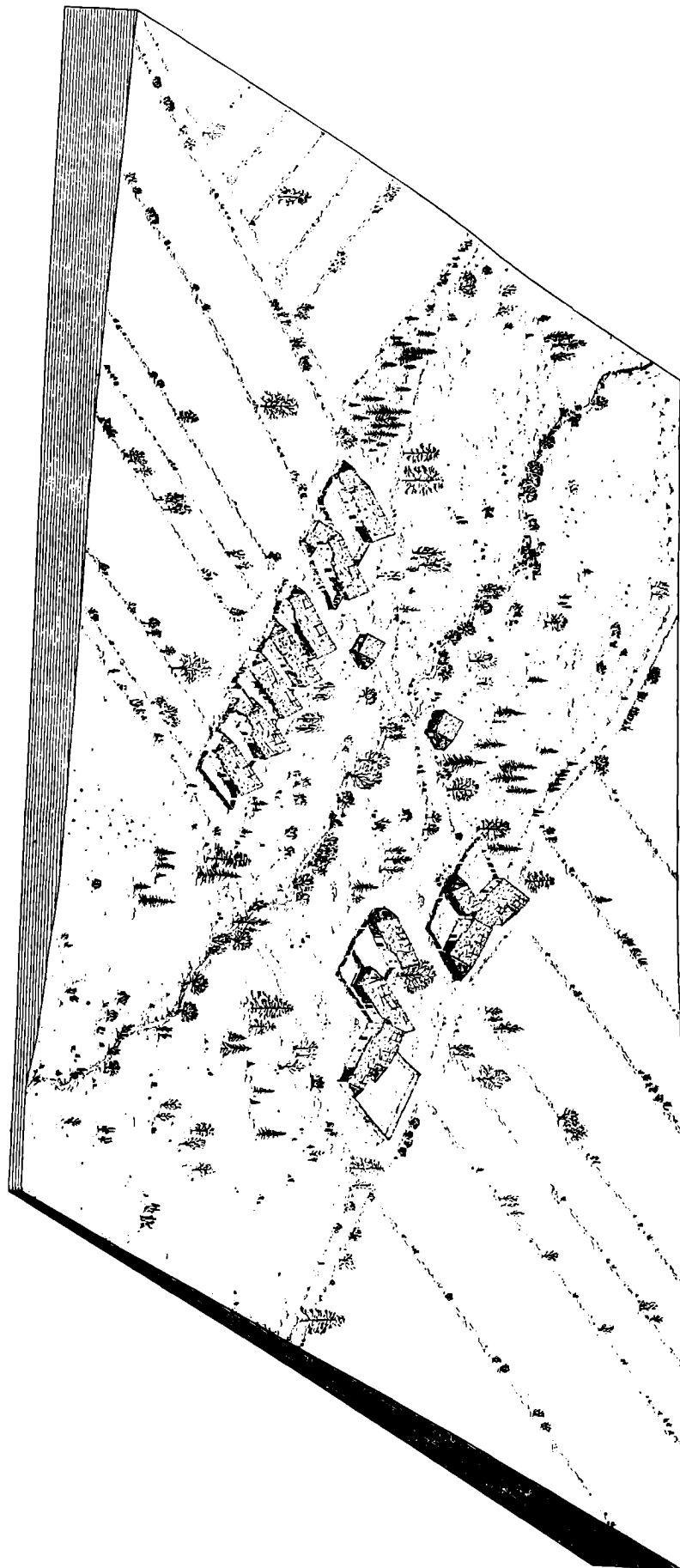


Fig 1 Reconstruction model of the 15th Century village

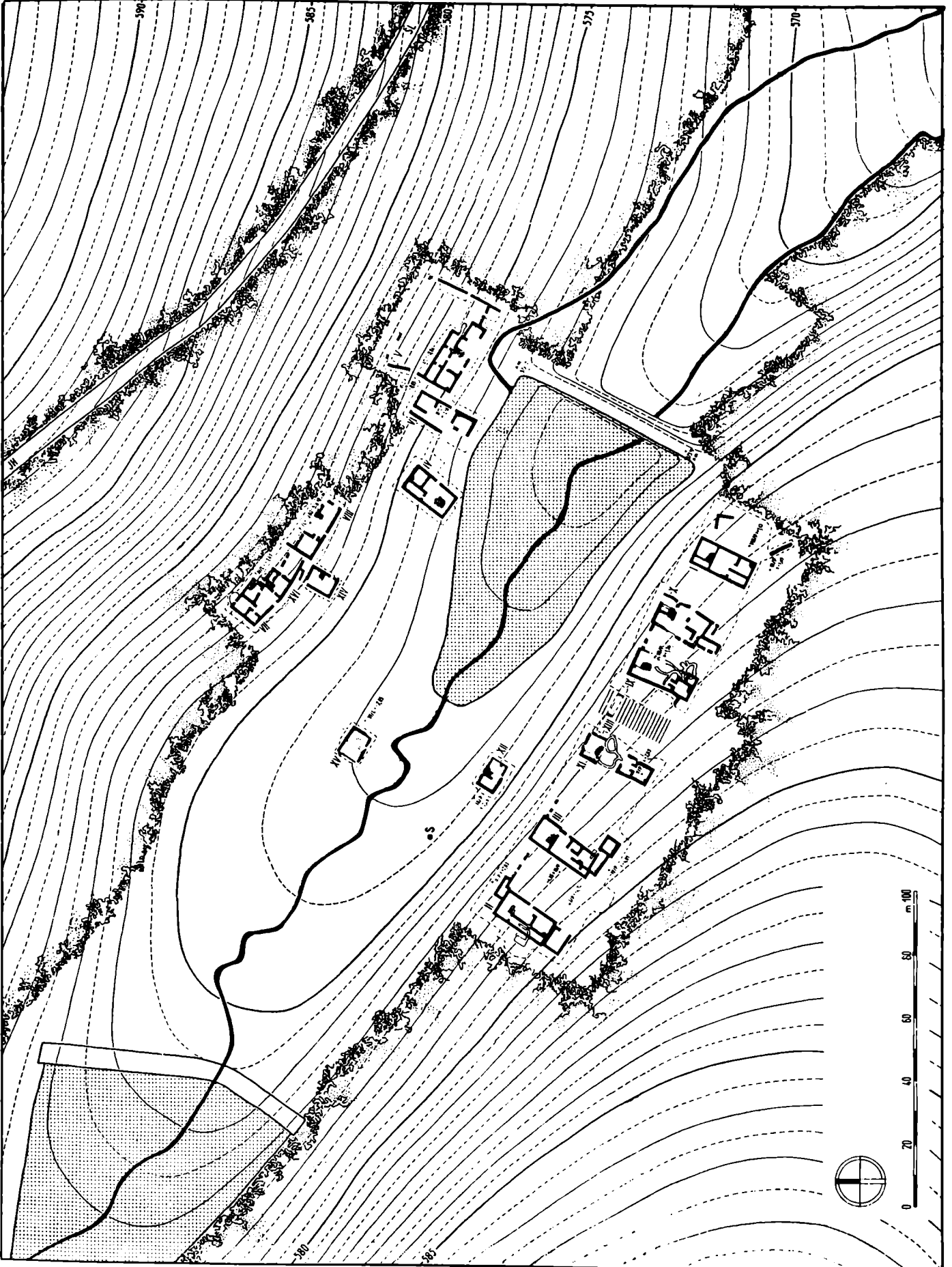


Fig 2 Contoured plan showing the excavated ground plan of the buildings

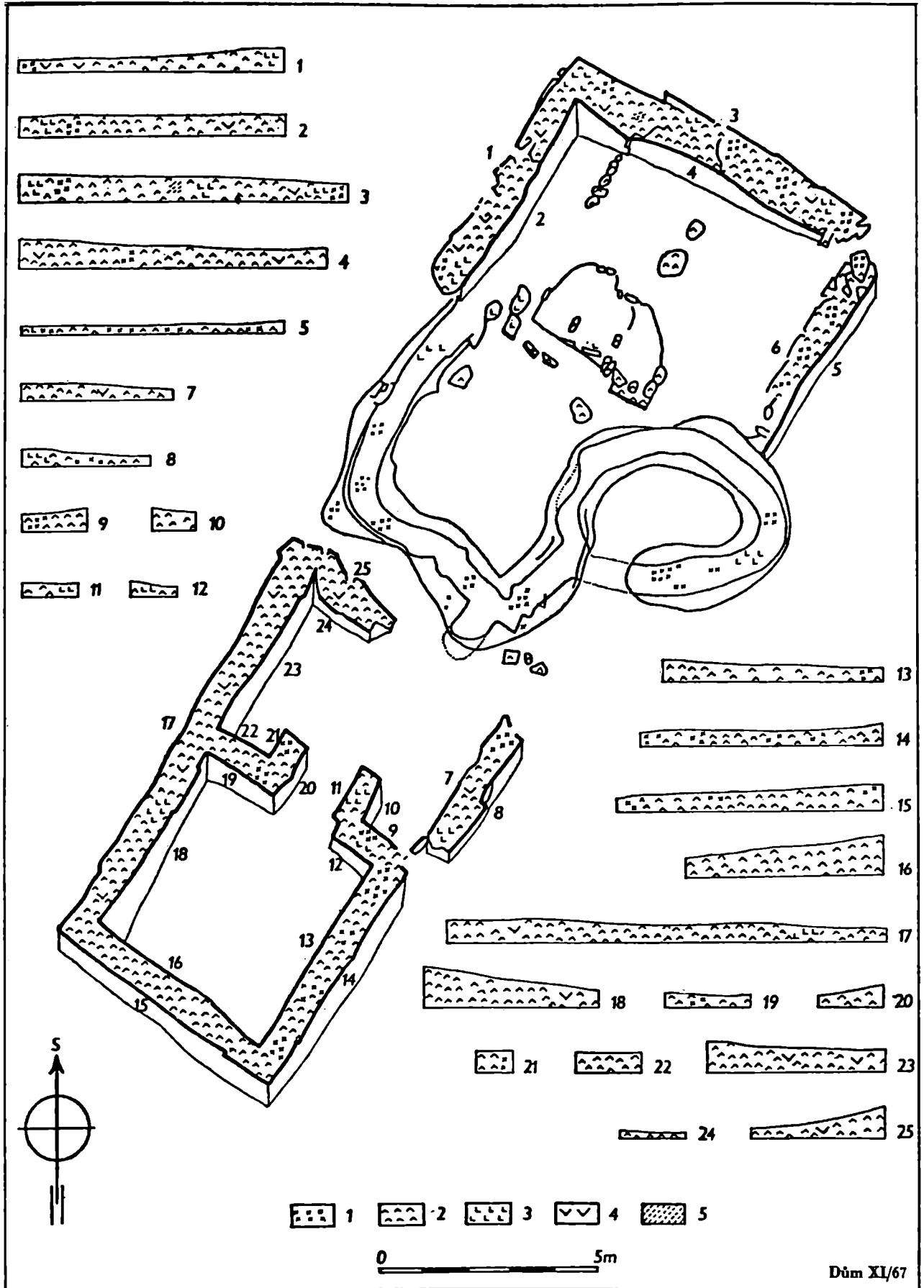


Fig 3 Diagrammatic plan of the underlying Erdställe

THE SOUTERRAINS ON SKYE

Paul Yoxon B.Sc. F.G.S., of The Isle of Skye Field Centre

Skye is the largest and most northerly of the Inner Hebridean islands which lie off the NW coast of Scotland. There are hundreds of miles of coastline which enclose peat moorlands and green valleys set against the rugged Black Cuillin mountains of gabbro and the rounded granitic Red Hills.

When trying to look at any prehistory on this island there is one main problem, and that is a total lack of research and literature on most of the prehistoric structures. This is even more evident when trying to find out about the souterrain which has also been plagued with a problem of terminology. The "Pict's House" and "Earth House" are both common names for the souterrain. The Revd Lamont, in his marvellous book *Strath, in the Isle of Skye*, talks about the chambered-cairn race of people using these structures as dwellings in the winter and then talks about Pictish children sneaking out of these after a stormy night. These vague and faulty labels can channel one's thoughts in the wrong direction as to the origins and uses of these underground structures.

We can divide souterrains into five main classes based on the construction techniques, namely:

1. Tunnelling into rock or clay
2. Use of natural features, cave or fissure
3. Wooded construction in an open-topped trench
4. Dry-stone building with an open-topped trench
5. Incorporation of the souterrain within the rampart or wall of an enclosure.

All of the Skye examples, without exception, fall into the dry-stone building class.

The problem of what other souterrains were used for cannot be dealt with in much detail in this article. I will put my points forward regarding the Skye souterrain only and compare it generally with what can be seen in the rest of Scotland. It would be totally wrong to believe that these belong to the same period as those in the rest of Scotland and Ireland and that they all served the same purpose, and to even assume they were built by the same type of people. It was F.T. Wainwright who pointed out that we should not assume that all underground structures belong to a single undivided class; as we do not classify all buildings above ground with one origin we should not do so with these underground structures.

Distribution

Figure 1 shows a map of the distribution on Skye of the souterrain. I am sure there should be many more which have not been found as yet or are totally destroyed, but

this is all we have at present.

The map appears to show a distribution with slightly more in the N and W. This is an interesting point in that most of our prehistoric structures on Skye are located in this area. As a side-line here for a moment, I have often wondered why the N and W of the island shows the most diversity of prehistoric structures if the early Neolithic and Beaker people came from the Rhine and Low Countries. One would expect the opposite sort of picture with a profusion of structures in the S.

The Souterrains

Out of the eleven structures on the island, only four are described in detail below. The others are recorded in old journals with scanty directions and although time has been spent looking for them, not all have been found. Those that have are in a very poor state and it is therefore only possible to give detailed descriptions and plans for the four best preserved. The remainder will be described briefly at the end of this section.

Ullinish (Figure 2)

Situated: half a mile N of Struan, at NG 333385

This structure is partly destroyed but what remains is in good order. It consists of a passage going in 3.9 m with an average height of 0.92 m and width of 0.9 m.

The walls comprise blocks of local Tertiary basalt and are all dry stone. Lintel stones cover the roof and these are large thin slabs of the basalt lava measuring about 70 cm long, 50 cm wide and 10 cm thick. The floor is bare earth.

The structure has two collapsed areas: the first section and also evidence of an oval chamber near the rear. This can be seen clearly on the diagram.

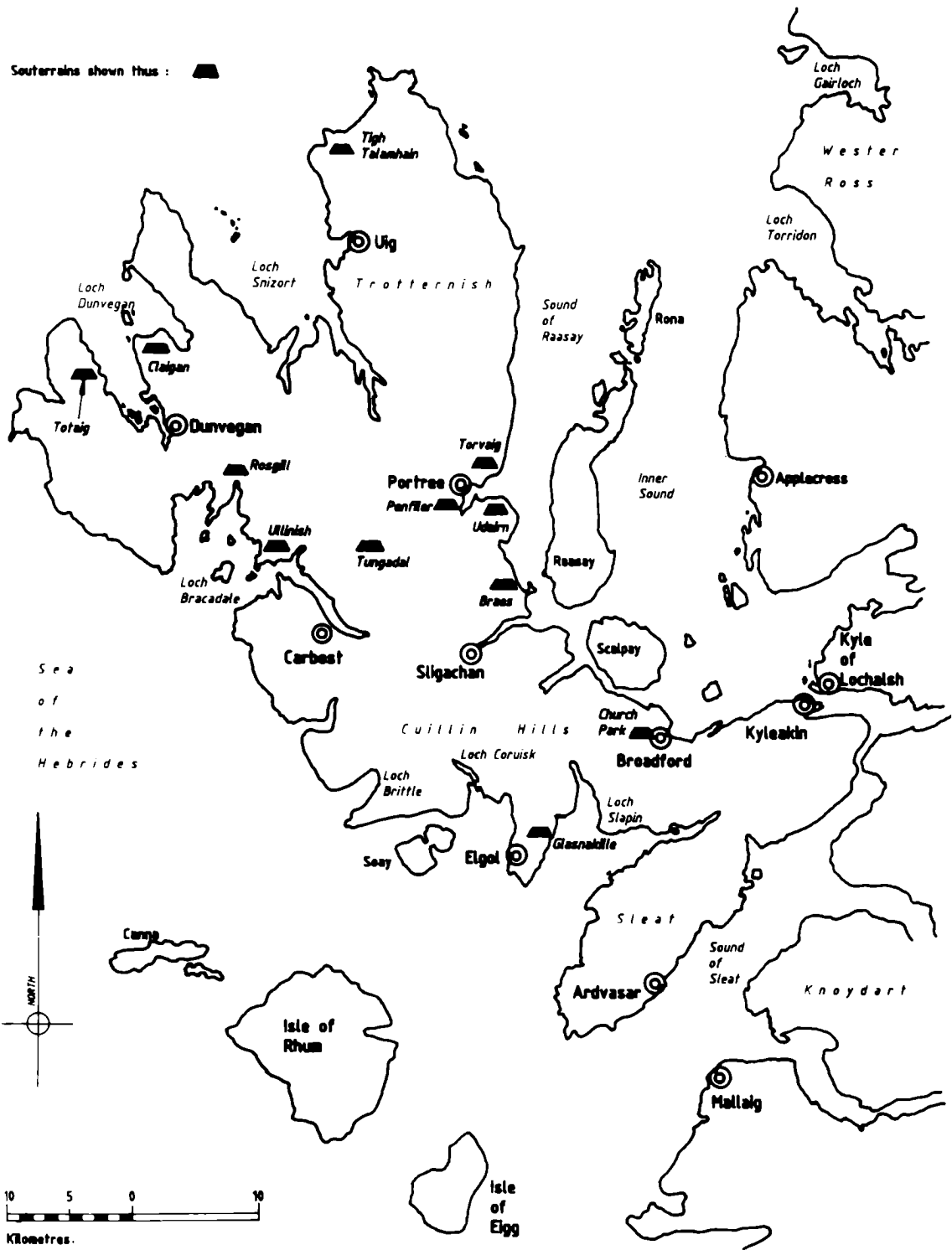
Claigan (Figure 3)

Situated: 4 miles N of Dunvegan, at NG 238539

One of the best preserved structures on Skye, this consists of a passage 9.8 m long which climbs at about 4-5° and narrows towards the end of the passage. The structure is made of dry stone basalt blocks with large lintel stones.

An interesting feature is a small compartment situated 0.5 m in from the entrance, the dimensions of which are 40 cm wide, 50 cm high and 37 cm deep.

Fig 1. Isle of Skye : Location of Souterrains



In the surrounding area there is evidence of habitation on a small scale, possible three or four houses, although it is very difficult to assess.

Tungadal (Figure 4)

Situated: near Loch Duagrich, at NG 407401

This souterrain is very similar to Claigan, consisting of 8 m of lintelled dry walled passage with an average height of 97 cm and an average width of 81 cm.

There are three interesting features in this souterrain, two of which are not seen elsewhere on Skye: firstly, there is a small compartment, very like that in Claigan, which is situated 67 cm from the entrance, as shown on the diagram; secondly, the construction differs from the others in that not only dry stone walling has been used but in places large blocks are only used to support the lintels; finally, there appears to be a ventilation shaft near the rear of the structure.

Fig 2. Ullinish

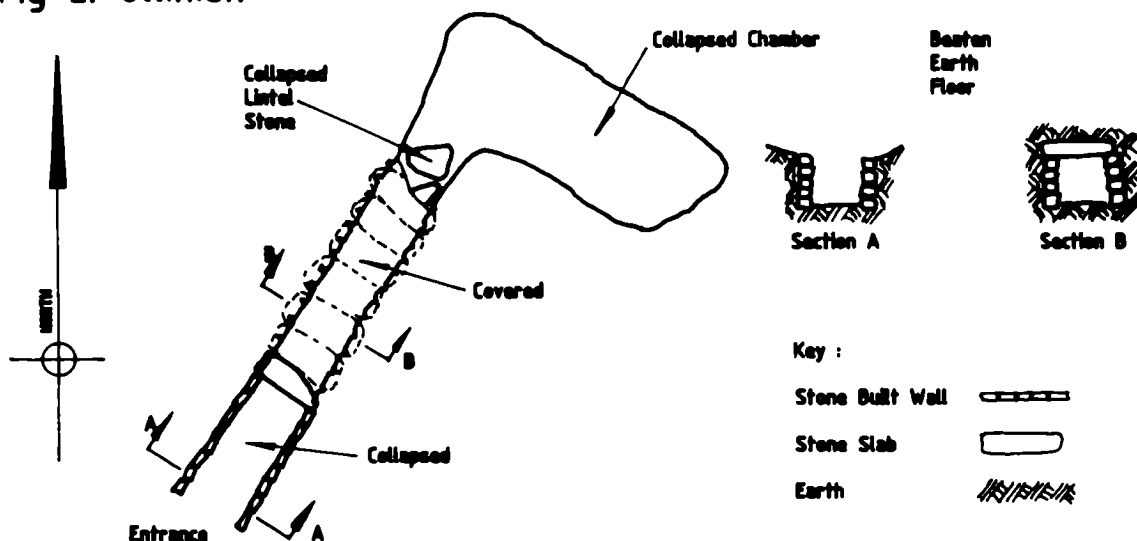
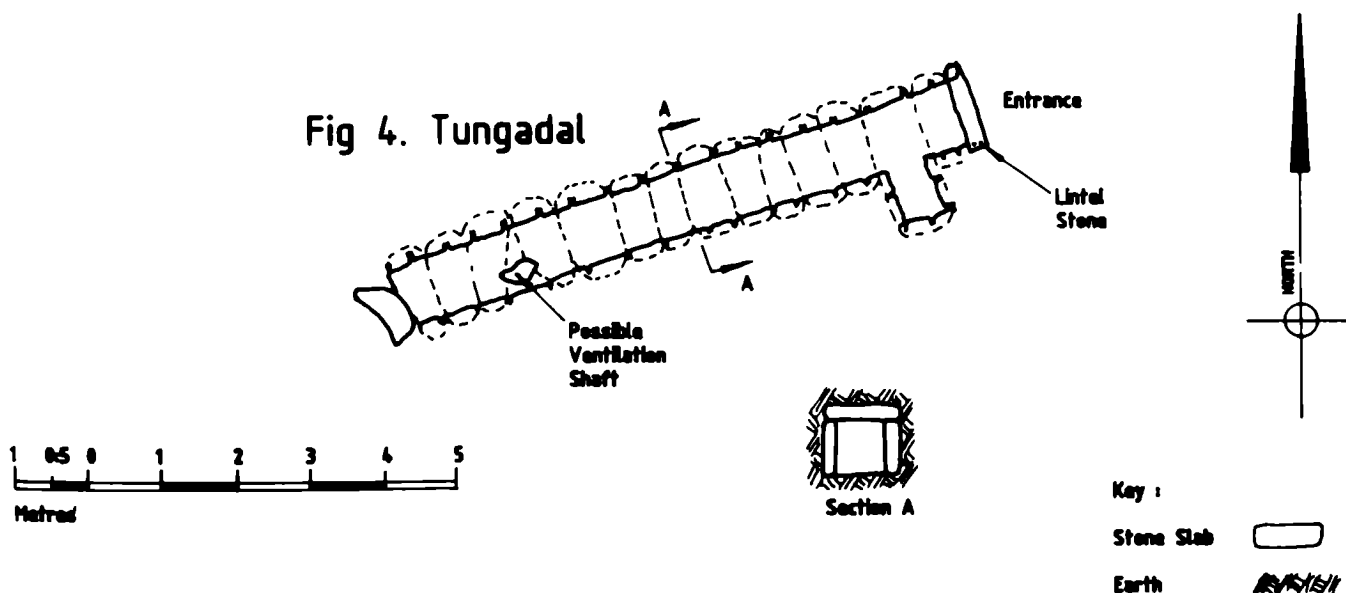


Fig 4. Tungadal



Tigh Talamhain

Situated: Glen Sneosdal, 5 miles north of Uig off the Heribusta Road, at NG 405695

This souterrain is situated in the remote area of Glen Sneosdal and is completely collapsed. The outline of the structure can be roughly seen to consist of a passage about 8 m long and 1 m wide. From what can be seen it consists of crude dry stone walling although no height or internal layout can be observed.

Glasnakille

Situated: three-quarters of a mile (1.2 km) N of Glasnakille at NG 542141

This souterrain has never been recorded and came to light in August 1987 with the help of a local man, Mr Johnson of Drinan. It is by far the best preserved on the island and is unique for a number of reasons.

Fig 3. Claigan

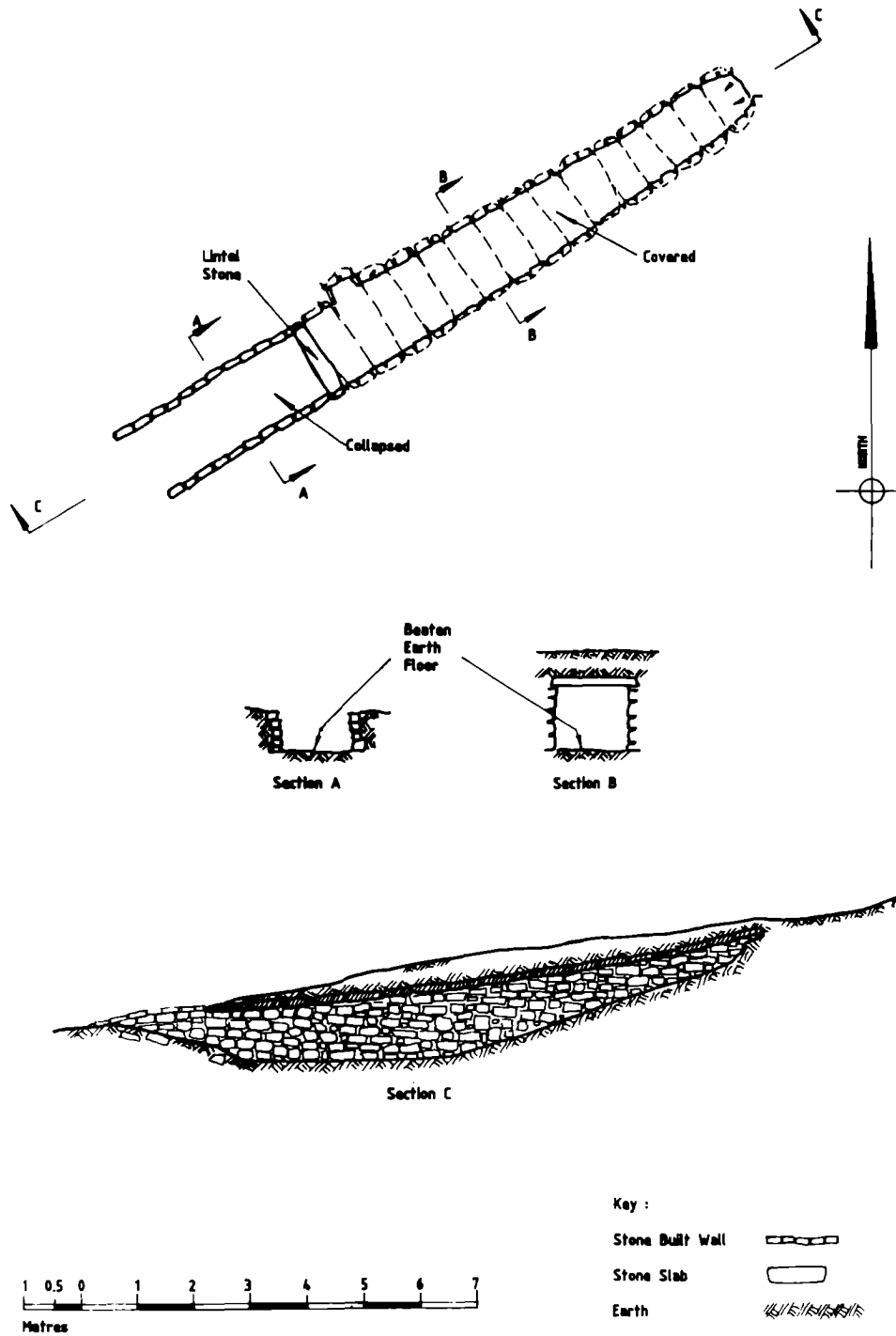
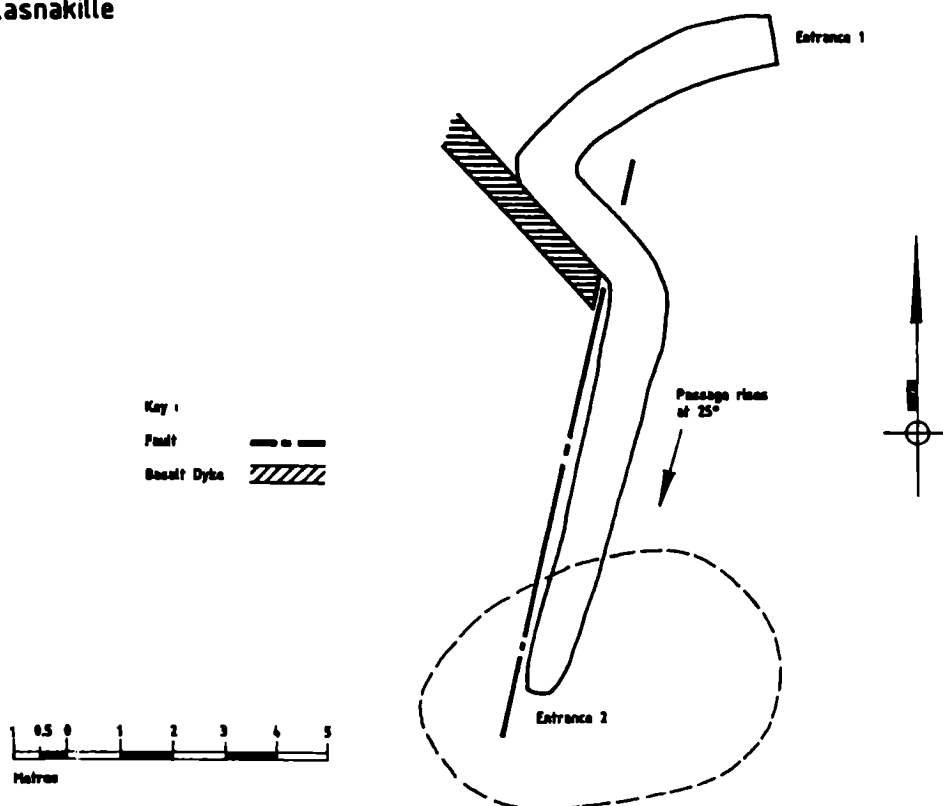


Fig 5. Glasnakille



Entrance (1) is 0.91 m in height and 1.03 m wide. The souterrain builders had used the natural rock as the main wall with small areas of drystone walling to level off the roof. The roof lintels are massive stone blocks measuring on average 1.4 m x 0.9 m x 0.2 m, mostly composed of sandstone.

The souterrain has two distinct kinks, unlike all the others on Skye, but it is the writer's belief that the original builders wanted to continue straight on but came face to face with a hard igneous dyke. They later found a fault which formed a weakness which could be widened out for a passage.

The structure is also much higher, with a maximum height of some 1.5 m.

The second entrance, or exit (2), is considerably smaller, being 0.74 m high and 0.73 m wide. This comes out into a crude hut circle measuring about 8 m in diameter.

The builder of this souterrain used a combination of natural geology, tunnelling and drystone walling to make this elaborate structure, and this contradicts our earlier belief that all Skye examples were of drystone wall construction.

The structure at Glasnakille throws a little more light on the origins and uses of souterrains. Similar structures attached to hut circles in Sutherland, Caithness and

Aberdeenshire are thought to have been food stores but these had only one entrance. However, as this structure has one entrance by the hut circle and another a short distance away it would seem almost certainly to be an escape route from the dwelling in time of trouble.

The souterrain controversy is left open. Obviously much more work is needed and there are still many more structures to be discovered. An excavation of the Tungadal souterrain is planned for 1988 and this will hopefully reveal more information.

Other Souterrains

Evidence for the rest of the souterrains on Skye is difficult as some show no trace today. The only evidence lies in records in old journals, the authenticity of which cannot be checked, but they are listed below with some comments:

Rosgill (NG 282449)

The entrance is in a bank overhanging the burn. It is very difficult to locate as it is totally collapsed.

Totaig (NG 203502)

There is no trace of building. A deep hollow marks the inner chamber and at least two side chambers are still intact, although most of the structure is choked.

Braes (no definite location)

This was discovered when a plough struck roof stones and consists of a long passage curving round to form a semi-circle.

Penifiler (no definite location)

This was destroyed between 1925 and 1927. When it was opened peat ashes were found at the end of the passage.

Church Park, Broadford

"A walled cavern was discovered in the church park not half a century ago (1913). So far examined by the late Dr Sutherland it appears to be one of these earth dwellings which Dr MacIntosh believes were built by these people of the chambered cairns.

"The entrance was about 4 feet [1.3 m] wide, the sides being built of unhewn stone, converging and roofed as in other similar dwellings. It is believed inhabitants of the Stone Age lived here only in the severest weather" (Lamont).

The other souterrains located on the map only have a brief mention in literature.

Age, Use and Origins

Without exception all the souterrains are built of dry stone walling in a dug out trench and all are associated with a settlement. These are generally small with no more than three, four or five dwellings and in most cases undefended with no fortified structure near them.

They have a long restricted passage with extremely difficult access through a low entrance. This is the general framework from which we have to build up an idea of the age, use and origin.

Although the concept of the souterrain is in fact much older than the Iron Age, the Skye examples are not unlike the Iron Age structures. However, as no archaeological work has been undertaken on them and no remains found, we have little to go on other than comparing them with other similar structures, so that a late Iron Age date for these Skye examples can only be postulated.

The purpose of these structures has been the subject of much debate. I have my own views on the Skye examples but will firstly try to eliminate other possible uses. The popular main contenders are:

1. Storage
2. Dwellings
3. Animal shelters
4. Refuge.

1. **Storage:** Many of the souterrains in SE Scotland are roomy, paved and well drained and the storage idea fits in very well. However, on Skye we have low entrances, narrow low passages, no pavement and water-logged earthen floors so that the use for storage is out of the question.

2. **Dwellings:** The "Earth House" concept I think can also be dismissed without further comment.

3. **Animal Shelters:** Again, we do not really have the room for such a shelter and the narrow passages do not favour such an argument. On a design principle this is "no go" and I do not think our Iron Age forefathers practised the inhumane way of battery farming that we do at present.

4. **Refuge:** Maybe by just a process of elimination, or perhaps an alternative answer still has to be found, but in my mind the only logical use for the Skye souterrains is a refuge. The size of them, the way in which they are all associated with a small community and would all have been well hidden when complete all point to this answer.

If a small group of farms do not possess any obvious defended structure they would have needed somewhere to hide their valuables and women and children at times of siege.

I am not suggesting that continual battles were raging, rather they would have been used when cattle raiders, call them what you will, were evident in the distance. Surely such a structure would give greater security to a small community who did not have the protection of castles, etc.

It could be argued on the other hand that these structures would be traps and the occupants could be smoked or starved out. This argument could equally be made for any defensive structure and any raiding party with enough supplies could easily overcome them. However, the main problem for these small Highland communities would have been "hit and run" attacks by small bands of cattle raiders hardly likely to wait around as this would have put their own families in danger from neighbouring raiders.

With regard to the small chamber structures in two of the Skye souterrains, it is difficult to give a definite use for these. It could be that they were further hiding places for valuables or storage places for food and drink for use whenever the souterrain was occupied.

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Archaeological site threatened by forestry development

An iron age underground chamber or souterrain in Skye was close to being destroyed by a private forestry development above the Struan area.

Fountain Forestry, who were carrying out the drainage and planting for an un-named client, have been sent a written rebuke by the Highland Regional Council but said the archaeological site was not marked on the maps they used.

Mr Paul Yoxon, who operates a field study centre at Broadford, discovered a large drainage furrow across the earth-covered, stone-built chamber and some damage to the stonework at one end of the 18-metre long site. "It was very near to total disaster," he said.

"I was horrified at what I saw. The site is marked on large-scale Ordnance Survey maps and obviously the forestry developers had not looked at the map for the Struan area. Sitka spruce and larch have been planted quite near the souterrain and when root systems develop it could be destroyed. This is part of our heritage from the iron age and once it is lost it is gone forever.

"With more and more forestry developments in prospect then many more of our archaeological sites will be destroyed."

A Fountain Forestry spokesman said they were "equally horrified" when told about the furrows across

the souterrain. The site will be restored to its original condition.

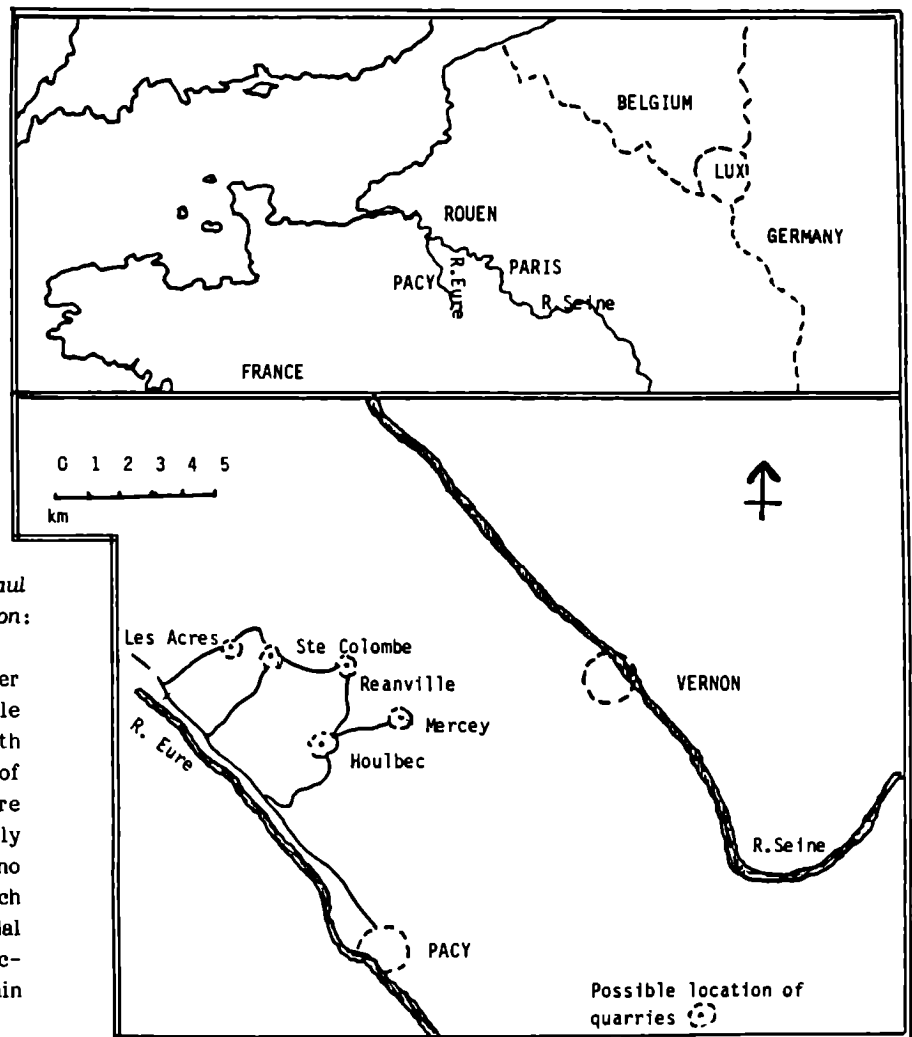
The spokesman said it was an un-scheduled site and was not marked on the maps they have. He added that Fountain Forestry have an excellent relationship with the ancient monuments authorities and have been complimented many times on their efforts to keep tree planting away from archaeological sites.

Highland Regional Council regional archaeologist Bob Gourlay said it was unfortunate the drainage furrows had encroached upon the souterrain which had been protected by the thick earth cover. He said the council normally have "an extremely good relationship" with the private forestry companies and with Fountain Forestry in particular.

Mr Gourlay added: "Ten to 12

years ago when there were few archaeologists on the ground, and nobody in the Highland Region, sites were in more jeopardy than as of now. In spite of increasing forestry development the sites are safer now than they were."

The earth-covered souterrain at Struan is one of two in well-preserved condition in Skye where two others have fallen in.



After submission of the above article Paul Yoxon sent in the following information:

"...The souterrain at Tungadal was under threat from private forestry (see article from *The West Highland Free Press*, 12th September 1986, below). The danger of archaeological sites from more and more development is, in my mind, a continually worrying problem. They have little or no protection and it was only during research for this article for you that the Tungadal souterrain was saved from total destruction by drainage and planting by Fountain Forestry... "

MILLSTONE EXTRACTION IN NORMANDY, FRANCE

Owen Ward

The pages of *Subterranea Britannica Bulletin* (No 19 of 1984) have already been graced with an article by Ken Major on the millstones in the Eifel region of Germany (pp 3-8). So far as I know, no such extensive underground quarrying for millstone has taken place anywhere

else in the world. But it does seem that relatively puny excavations were carried out in order to extract millstones in the north of France. A report of 1758¹ says that blocks of millstone occurred in a stratum amongst sand some 40 feet (12 m) below the ground at Houlbec, in Nor-

mandy. The shafts dug to reach this depth were conical (wider at the bottom), and in order to take out the blocks of millstone "the quarrymen form a sort of gallery which they shore up with pieces of timber. This is to prevent the sand from caving in, which does nevertheless sometimes happen in spite of all their precautions. Such galleries are usually no longer than the length of a block of stone". How long is a block of stone? Elsewhere in the report these are stated to be no more than 8 feet (2.5 m) long by about 4 feet (1.2 m) wide; hardly big enough for the tunnel beneath them to be described as a "galerie"!

However, the shafts obviously penetrated to some depth, with unexpected consequences. "The quarrymen do not begin work there until All Saints' (1st November) and they stop during April or early May: this they are obliged to do because the shafts are so cold in summer, though warm in winter. They say that they can catch their death of cold in them in the summer, although most of the pits are no more than 40 to 45 feet (12-14 m) deep; it is true that some can be as deep at 50 or 60 feet (15 or 18 m).

The reporter was aware, in 1758, that in truth the temperature 40 feet (12 m) below ground is, if anything, a little higher in summer than in winter, and wondered what made these men so extraordinarily sensitive to changes in temperature. He did concede that in the course of their work as millstone makers they had to be in and out of their pits quite often when hot and sweaty, and perhaps therefore more prone to the effects of the cold air.

This report, which contains other details of the stone, has interesting implications for molinological history which will be followed up elsewhere, but it would be interesting also to know whether any trace exists of these 'quasi bell-pits'. They may still give rise to disturbed ground in the areas referred to in the 1758 report, and interpreted as shown in TABLE 1 below. Do any of our English or French readers know of any such disturbed ground?

1. Guettard, 1758, "Memoire sur la pierre meuliere" (Histoire de l'Academie Royale des Sciences).

TABLE 1. Interpretation of Locality Names from Guettard, 1758

Name in 1758 Report	Comments	Suggested Interpretation	Location
HOULBEC	Said to be "près Paci en Normandie"	HOULBEC-COCHEREL	6 km NNW of PACY-sur-EURE
STE COLOMBE		STE COLOMBE-près-VERNON	9 km NW of PACY 10 km W of VERNON
HERIANVILLE*	No such place?	REANVILLE	9 km N of PACY
ANTOUILLET*	"dans un endroit appelé les Acres"	LES ACRES 2 km NE of AUTHOUILLET	10 km NW of PACY (in the Bois Brûlé)
MERE*	MEREY is 10 km S of PACY: more likely to be	MERCEY	7 km N of PACY
* Many 18th Century reports are even more unreliable about place-names than about ordinary spelling: no doubt word-of-local-mouth is responsible. Similarly:			
ST OUEN*	70 km E of PACY (as the crow flies) on the outskirts of Paris: on the River Seine	ROUEN	Also on the Seine, and a known entrepôt for millstones

MILLSTONE MINE AT WALDSHUT-TIENGEN, BADEN-WURTEMBERG, WEST GERMANY

Franz Falkenstein, edited by Arthur D. Dunn

It has recently come to our attention that a mine where formerly millstones were produced, lies just to the W of the little town of Waldshut-Tiengen on the Rhine, close to the border with Switzerland. This mine, or mines - as there seem to be a number of them up the little valley - is located in the Liederbachtal, some 1500-2000 m N of the railway. The road to the mine is about 200 m from the railway line, where it crosses the Liederbach stream. At the entrance to the mine which we visited, was a workman's house with a smithy, presumably for the setting up and sharpening of the drill bits used in the mining of the millstones. The mine is closed to visitors at present, but it is understood that it may be opened to them later. It is closed partly because of the possible danger to visitors, but also because at certain times of the year it is a sanctuary for a particular type of bat, of which studies are being made, and conservation of this particular type of bat is being considered.

As far as can be determined, these mines could have been worked as early as the 15th century, as in 1531 they were of enough importance for the city of Waldshut to publish an Edict regulating the operation of the mines. The Edict seems to indicate that there was considerable competition in the manufacture of millstones, and it might have been possible that there were other millstone mines not too far away from the Liederbachtal. The Edict (*Steingruben-Ordnung*) reads in part as follows, broadly translated:

"There is little obligation for the millstone makers to make bad stones, or in some way hinder competition. The stonemasons are not in a middleman's position when it comes to selling millstones. When a purchaser visits you, you must take him to the mine and show him the stones that you have, and negotiate with him. Because prices are not fixed, one has to accept that the purchaser may wish to go to another supplier and not be hindered in doing so. Not to allow this is punishable by a fine of a Silver Mark, which must be paid unconditionally."

It also states:

"No wine is permitted in the mines, violators being punished (by a fine of) three pounds in small coins."

The latter portion of the Edict was necessary because the operations were both difficult and dusty and the miners needed some fluid to quench their considerable thirsts (and also to counter the ingestion of the stone dust into their lungs). However, many people were surprised at the statement, as the nearby vineyards of Waldshut and Döggern, on the slopes of the Black Forest, were quite close. Probably the main reason for the prohibition was that the employers were concerned that the miners might become

drunk or incapacitated, and so neglect their work.

The Edict goes on to say:

"When the purchased stone is loaded and carried away, the carrier or (the) stonemason in the communal forest must not cut down wood in return for the stone, because the timber is required for other purposes. Further, all stonemasons must help one another to load and remove millstones from the carrier's waggon to the store for a payment of not more than one Guilder for either a bedstone or a runner stone. Also, whenever a stone from the mine is to be transported, everyone must provide assistance according to the old customs. Also, the (waste) material must be tidied away, and not into the town brook, on the pain of punishment by the Government."

"Not every servant (workman) may be recruited for the work, but every servant (workman) who has already worked for a long time for their master, and who has promised to stay with him, must keep his promise. Whoever fails to keep his promise is to be sent away from the gateway of the town and forbidden to set foot again in the town."

About the middle of the seventeenth century, with the development of the use of gunpowder (black powder) blasting in the mines, a new problem for the miners was discovered; fewer miners were needed to remove the overlying rock to gain access to the millstone beds. This new process demanded many new skills, and the careful and correct application of the use of explosives. No longer was it possible to use water to reduce the amount of dust in the atmosphere so they had to be drilled dry, and in such a way so as to remove the wasted rock without damage to the millstone beds. Water in the drilled holes would result in the failure of the black powder igniting, with possible serious results.

The walls of the drilled holes were then quickly cleaned with clean rags (*Bohrschwamm*), possibly to remove the loose stone granules and any slight dampness which might cause premature explosions, or failure of the charge to explode, which in either case might endanger the life of the miner. Afterwards, a cartridge was placed into the hole in which a charge of some 4-8 Loth (1 Loth = 15.62 g) of black powder was enclosed, the cartridge being made either of paper or leather pasted together and containing the correct amount of black powder to obtain the best result.

Into the cartridge was then pressed a long conical needle called a *Schiessnadel* to provide an access, or touch hole, for firing the charge. This device was made from a

a knife or a piece of hardened brass. The needle appears to have been lightly oiled in an endeavour to reduce possible sparks. Then with the needle still in position, a paper plug was inserted into the hole and then some small stones (probably with some clay, or clayey earth), and the whole was pressed in tightly. Afterwards the charge was further compacted by means of a wooden hammer, and the pin removed and replaced with a hollow reed or straw filled with black powder.

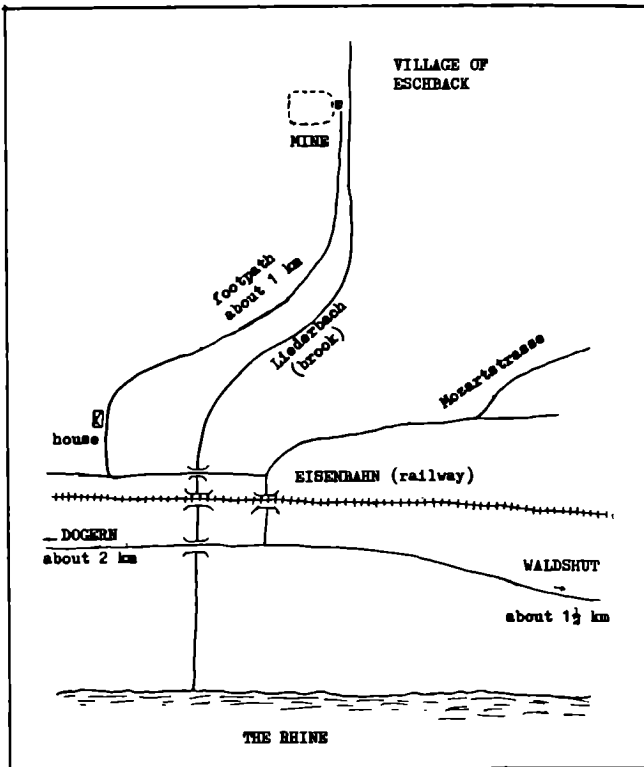
In order to fire the charge, before the use of matches, a firebrand was used, and this was applied to a fuse (*Zundmannchen* - "little fuse man") made of a sulphur-charged wick whose length was adjusted to provide the

necessary security for the miners. If the charge failed to function the existing hole was filled with water, and a new hole was drilled and re-charged.

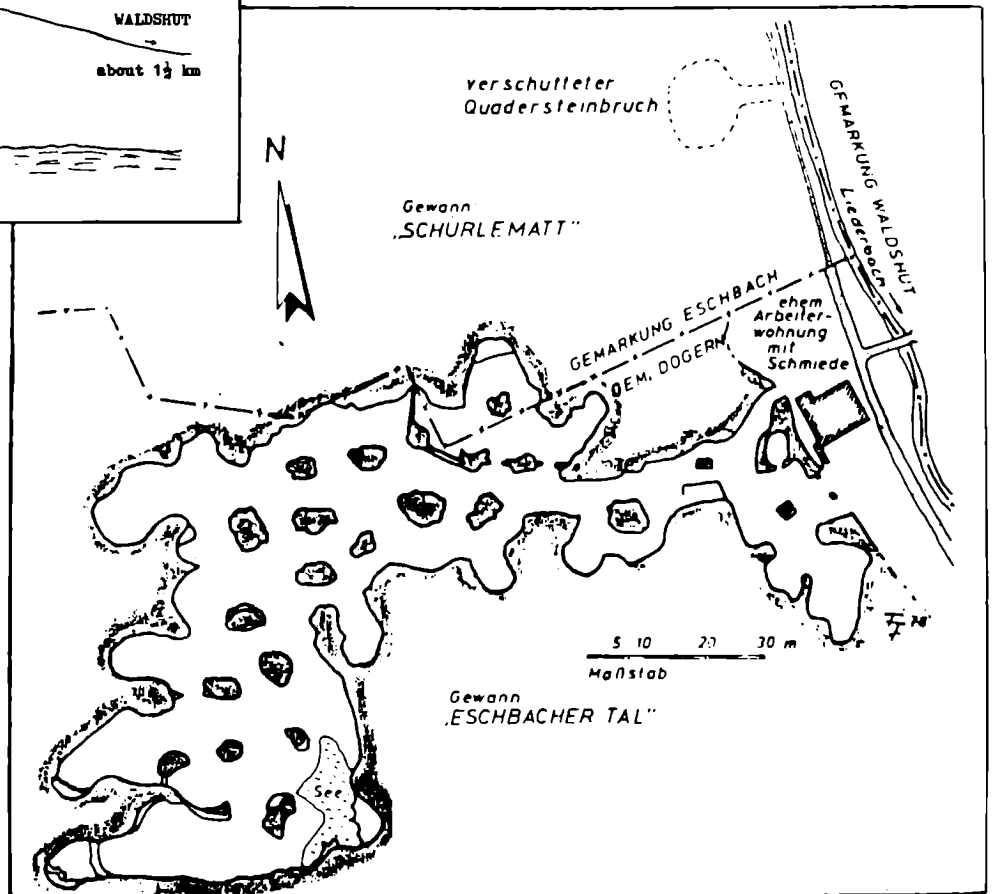
The miners left pillars of stone standing at frequent intervals to support the roof, particularly since the sandstone of the roof of the cavern gradually crumbled and loosened large pieces of stone that could become dangerous to the miners.

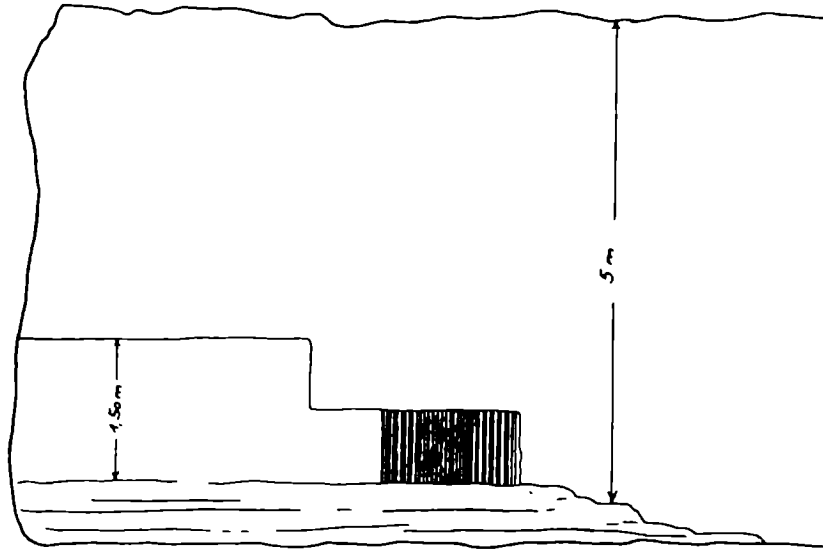
Access to the mine is no longer permitted. The exact German wording in the Edicts can be obtained on request from the Editor.

(With acknowledged thanks to the authors for permission to reproduce this article; and for the photographs to the Molinological Society - J. Kenneth Major)

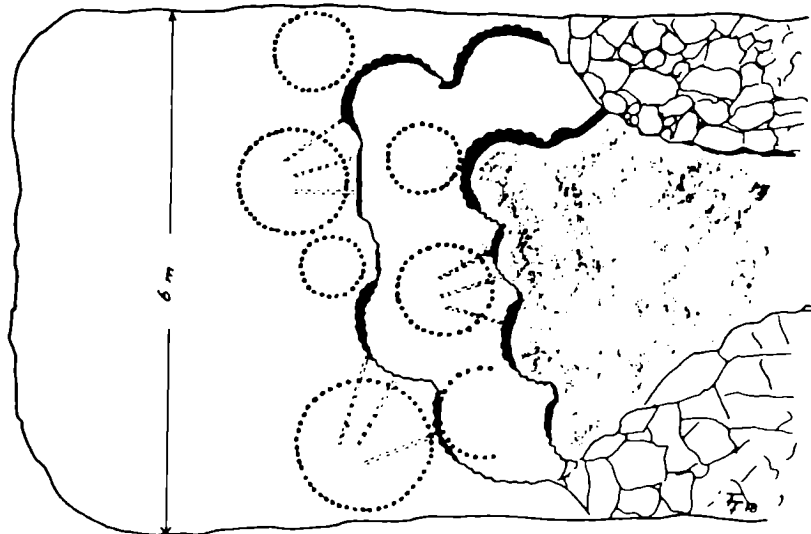


Plan of the Millstone Mine "Bleiche-Waldshut" on the Leiderbachtal, near Waldshut

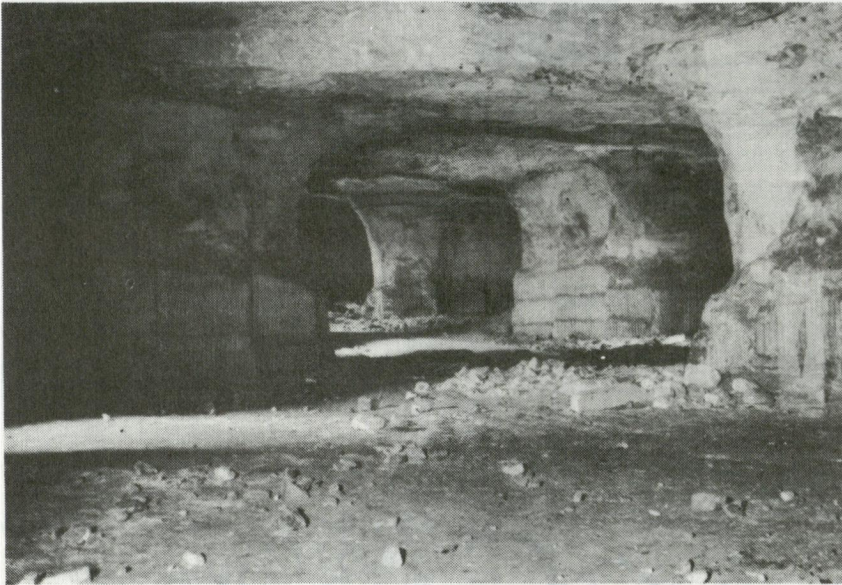
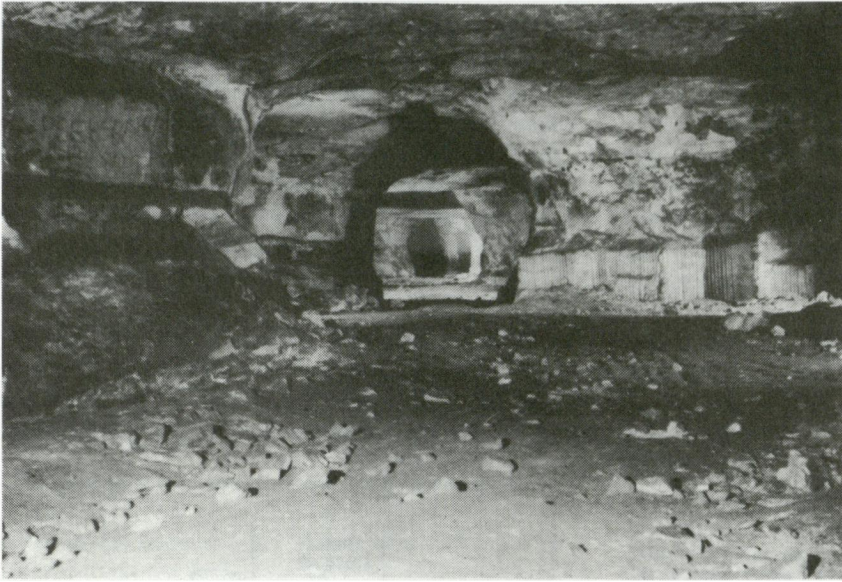




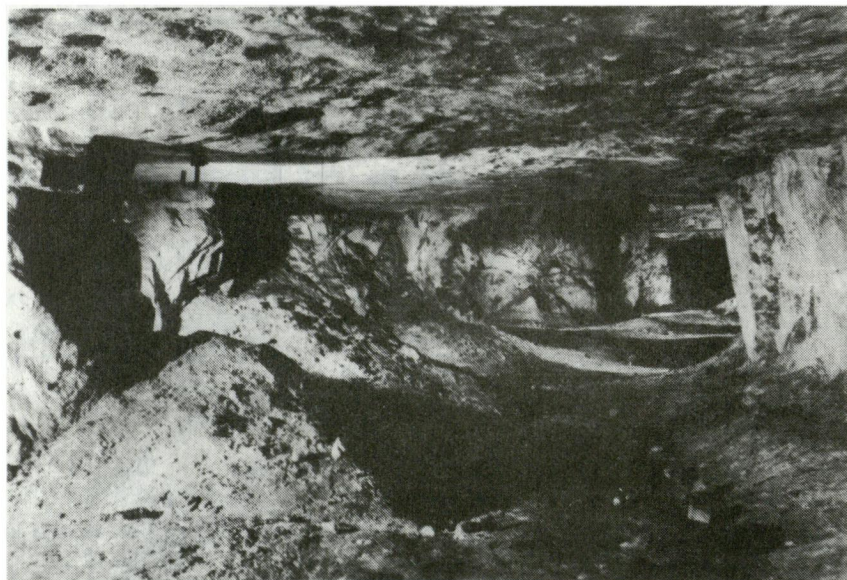
Section through the mine



Plan showing the sites of the millstones in relation to the mine



Millstone Mine "Bleiche-Waldshut" on the Leiderbachtal nr. Waldshut.



The Sandstone mine "Quarzmühle nr. Waldshut

FUNDAMENTAL ASPECTS OF PREHISTORIC MINING

Robert Shepherd

Although prehistoric man mined materials other than flint, most of this short paper is confined essentially to the extraction of flint in Neolithic times. The reason is that there are many more remains of flint mines compared to those of the metals, these having been mostly destroyed by later workings. Flint mines mostly remain undisturbed because the product no longer has the great economic value it had in Neolithic times.

In the context of this survey the parameters which will be high in the priority of an engineer are numerous and can be summarised as follows:

1. Methods of working
2. Labour
3. Support of strata
4. Tools
5. Lighting
6. Ventilation
7. Transport
8. General considerations including customs.

Methods of Working and Layout

The first impressions arising from a casual glance at one of the many plans of flint mines, both in Britain and on the Continent of Europe, are those of lack of method and uneconomical extraction. Flint is deposited usually in even layers, although there are exceptions, and from the point of view of safety and economy can be worked reasonably satisfactorily. Furthermore the parent rock, chalk, being relatively soft, is easily worked by primitive tools such as those made from deer antlers. There are exceptions such as the hard chalk in the Netherlands and Belgium, or where chert was worked in limestone or sandstone strata. Under such conditions flint tools would be more effective, as would the use of firesetting. In British conditions it was not necessary to employ such methods.

On looking more closely at many British flint mines and indeed a great many on the Continent of Europe, it is possible to discern some intention to plan layouts by the even distribution of galleries and pillars. The idea would be to drive galleries radially from each shaft, the intervening spaces being in the form of chalk pillars. When a gallery became too long for the manually operated transport system, another shaft would be sunk, the galleries interconnected and the old shaft backfilled with the debris from the shaft being sunk. In many British flint mines shafts are connected by such galleries. Why then was there invariably some departure from such layouts as, for example, the very untidy one at Cissbury? The explanation appears to be that prehistoric man endeavoured to get all possible available flint as near to the shaft

as possible. Accordingly he drove connections between galleries at random, broke through pillars and created falls of ground and the workings finally ended on a ragged note. It is possible that groups of miners, or odd itinerant wandering workers, appeared on the scene and robbed the workings of flint and departed with their spoils.

Another explanation might be the time factor: prehistoric mines are in some cases at least 5,000 years old. During this long period, and long after the original miners had gone, they must often have been visited by peoples eager to get a quick and comparatively easy haul of flint, especially during the later Bronze and Iron Ages. Consequently the orderly arrangement would be destroyed, not by vandals as the work would have been too arduous and dangerous, but by possible users of flint. In addition, open pits or shafts would become refuse pits and be used by later occupants of the area.

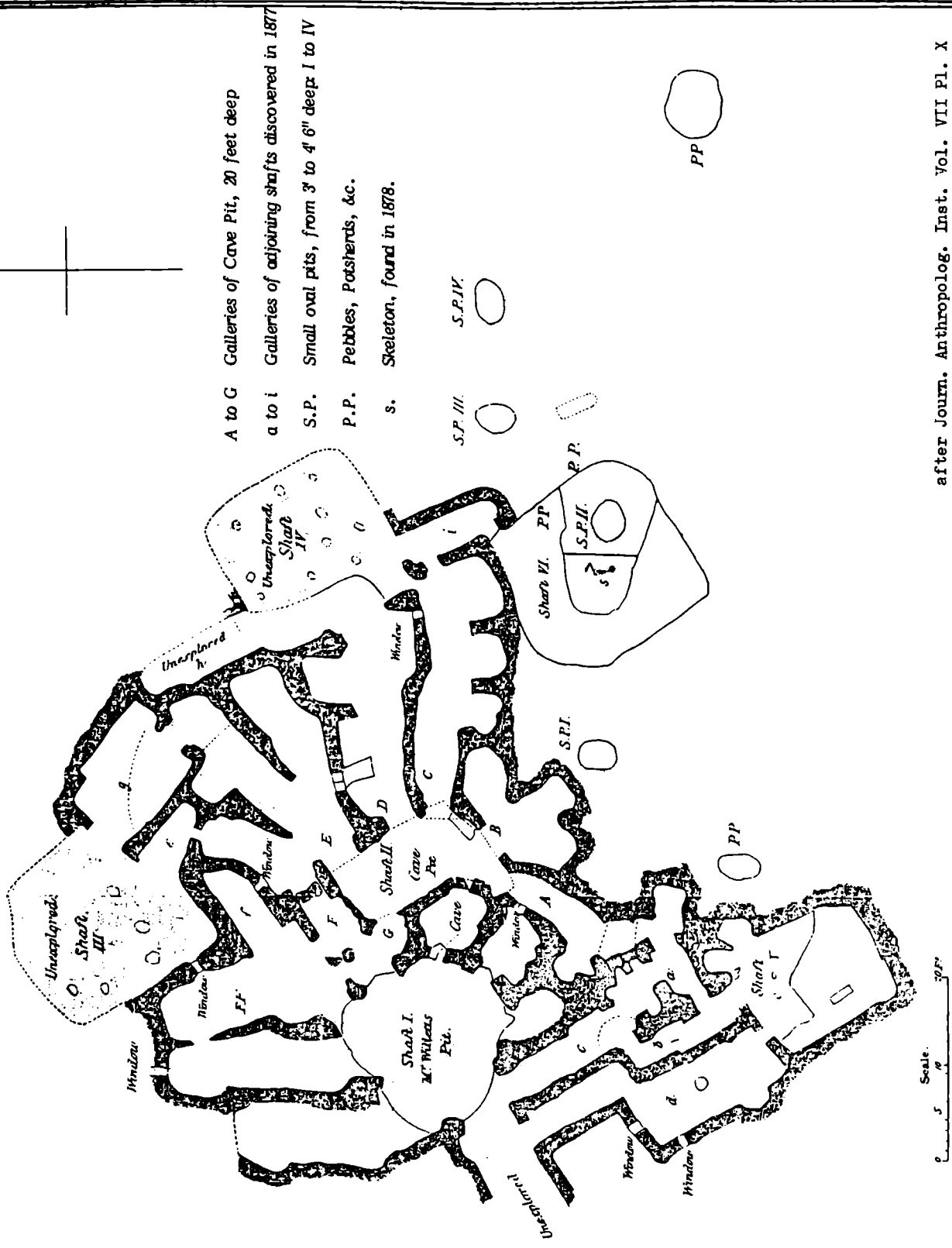
Curious symbols have been found etched on roofs and sides of British flint mines, typical examples being found at Cissbury and Church Hill, Sussex (Fig. 2). Workers in the 19th Century suggested that they could have been made by antler picks, flint tools or even badgers! Some apparently fresher marks have been thought to have been made by modern tourists, but the depth and inaccessibility would rule out this conjecture. Some of the etchings have a characteristic geometrical arrangement, as one at Church Hill. This could possibly have been related to a method of determining the width of a pillar between two parallel or near-parallel galleries, or possibly used as an aid to discussion between two miners regarding layout. The other symbols appear to have some relationship, possibly to a ball game, but the true implication is likely to remain a mystery.

Support

Experience in deep mining has shown that the need for artificial support is not necessarily more apparent in deep mines than in shallow workings. Usually what happens is that, although primitive stresses - being 2,182 kg/sq m per metre of depth, which is about one pound per square foot per foot of depth - increase with depth, after an excavation is made there is a redistribution of stress; when two abutments are formed a little way on each side of the excavation, each has a value of something of the order of four or five times the primitive stress. This creates more favourable conditions within the excavation, i.e. a fortuitous concession from nature.

In the immediate roof layers, excavation over the bed separation takes place. This is usually very apparent in shallow workings, but is not so marked in deeper ones. The significant feature is that supports are not needed

FIGURE 1. Cissbury: Plan of Excavations made in 1876 & 1877



to support the whole of the strata up to the surface, even if this were possible, but only to hold up the sagging beds and the consequent immediate broken strata. Wood props to support the immediate beds could be as much an advantage in shallow workings as in the deeper ones. Usually chalk can be self supporting, or in mining terms competent, provided the galleries are not too wide. When falls do take place they are generally the result of blocks of chalk sliding along joint planes.

When a prehistoric mine is opened up it is often found that some galleries can be entered freely while others are blocked by falls which have to be removed. A depression on the surface does not always represent the site of a shaft, but may be the ultimate result of subsidence above a wide gallery.

Despite the many areas of forest land in Neolithic times in Britain, there is no evidence of timber having been used in prehistoric flint mines. Timber does not of course readily survive with age, but in British mines there are few notches or crevices in galleries for the reception of props and bars. Some have been found in shafts at Grimes Graves, but these were probably for the easy erection of ladderways or staging. On the other hand, miners realised the need to leave pillars of unworked chalk and the concept of the shaft pillar, as in modern mining practice. It was the wilful removal of pillars which often caused falls of ground. It is interesting to note that in ancient Greek mining the removal of a pillar of ore-bearing rock used for support was punishable by death. Often packs of chalk blocks were built to provide support, but mostly to get rid of unwanted waste material to save sending it to the surface. However, removal of these packs during investigation has often resulted in roof falls.

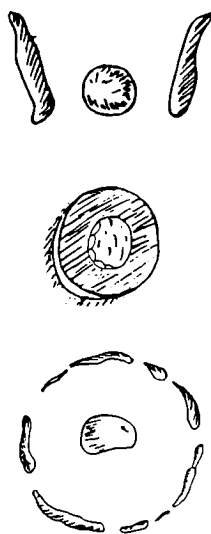


FIGURE 2. SYMBOLS OVER ENTRANCES TO GALLERIES AT SHAFT 4 CHURCH HILL

Lighting

Daylight was often adequate for the workings in shallow pits, but with galleried workings some form of artificial lighting was required. This took the form of lamps burning animal fats. There is some evidence in some mines for what are termed 'windows' between galleries. These have been thought to have been used for the ascertainment of widths of pillars, but it appears more realistic to presume that, according to the positioning in plan, they were made to enable more light to reach parts of the workings.

Ventilation

Prehistoric flint mines were shallow and the maximum lengths of galleries were rarely more than five to ten metres. Also many galleries formed interconnections between the shafts, so ventilation should not have presented a serious problem. Air flow could, however, have become stagnant in longer closed galleries thereby resulting in some abnormal accumulation of carbon dioxide or "blackdamp". Natural ventilation could have been induced if two shafts formed the network, and especially if the base of one shaft was higher than that of the other. This would result in the induction of air flow or, in mining parlance, "ascensional ventilation". There is no evidence in Britain of the use of furnace ventilation and, despite mention of this on the Continent, the evidence is weak. Finds of charcoal have even been given as evidence for furnace ventilation, but were probably used for making fires for warmth and cooking.

Transport and Access

Not only were short galleries advantageous from the point of view of ventilation, they enabled debris and flint to be transported fairly easily by manual effort. There is some evidence from marks on the walls of shafts and galleries that ropes were probably used to haul baskets in both galleries and shafts. Recesses cut in the sides of shafts could have been meant for the fixing of staging for ladders. Such ladders were probably constructed from branches of trees lashed together with hide cords.

Transport was often eased by first crudely dressing the flint nodules underground or on the surface. This would reduce the weight to be carried and the final dressing to create the finished tool would be carried out at the village or habitation site. Finds of finished axes are rare at mine sites and this would appear to support this supposition. The only finished tools found at mines are those which would have been used for the preparation of food such as for example knives. Taking all the evidence of lack of maintenance of the original plan of work, the absence of finished axes and the finding of tools used for food preparation etc., it can be assumed that families came from the villages, camped at the mines, collected rough pieces of flint and went back to their homes where the flints were made into tools and weaponry.

- A - filled in trench
- B - soil or humus
- C - trench
- D - seam of nodular chalk
- E - chalk
- F - gallery
- G - site of skeleton found in situ

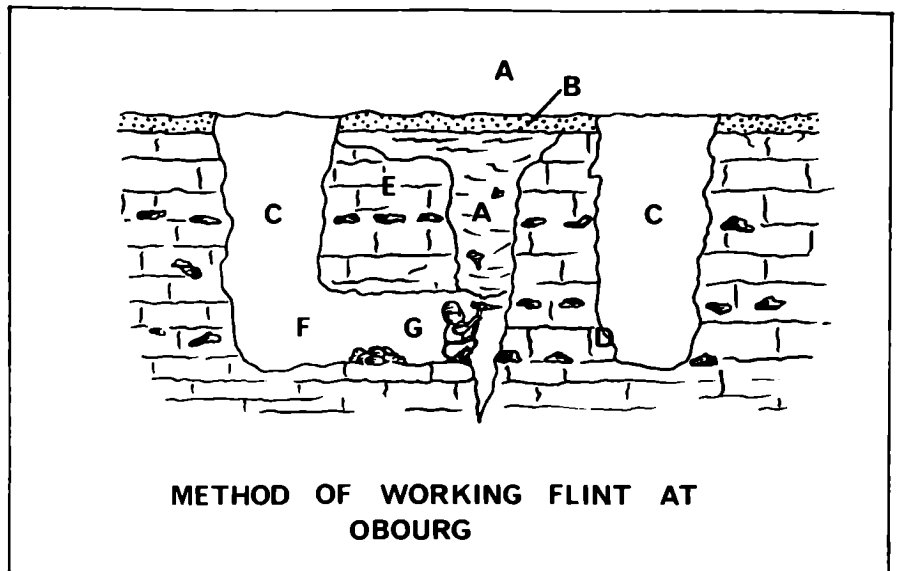


FIGURE 3. Method of working flint at Obourg

So far only prehistoric flint mines have been considered, but there is one major prehistoric mine worthy of mention at Mitterberg in the Austrian Tyrol which worked copper pyrites around 2500 BC and later, up to the Roman occupation of the area. Prehistoric copper or other metal mines are very rare as mostly they have been destroyed by later workings. The Mitterberg mine appear to indicate that in the Bronze Age miners had understood the practice of ascensional ventilation, the layout of workings to control the egress of water, the support of workings with wood props and bars, the large scale use of firesetting and the metallurgical treatment of sulphide ores by pre-roasting to remove sulphur.

Conclusion

The finding some years ago of a skeleton of a miner in a working position in a mine at Obourg in Belgium tends to support the theory that mines were often visited by odd miners in search of flint. Here probably a wandering miner found a couple of trenches open with a partly

excavated gallery intended as a connection. While extracting flint from the gallery the man worked under a filled-in or abandoned trench which partly collapsed, so killing him. It is easy to interpret this situation by modern standards and indeed it is a temptation to do so. Why was a body left in the mine and not given a decent burial? Either there was no check made on the number of people in the mine or there was a complete disregard for the sanctity of human life. Some archaeologists have spoken of the possible existence of a socialist Neolithic society, but there can be no completely reliable evidence. It does, however, appear that prehistoric flint mines were common property with no individual or group ownership, but free for all, the pits being used as required.

In this short paper it has only been possible to deal with a few of the significant aspects of prehistoric mining, chiefly of flint. There are probably more flint mines waiting to be discovered than are at present accessible for inspection. When more work has been done it will be more opportune to confirm or repudiate existing theories.

THE GOLDEN CALF: SOUTERRAINS IN SOUTH SAINTONGE (Charente Maritime), FRANCE

Regis Neveol

Introduction

What village in Haute-Saintonge (see Michelin Map 71), in South West France, does not possess one or more, often several, "Souterrains"?

Some think that the expression "Golden Calf" associated with these is to be taken literally; they compare it with

folklore from other regions, and think that the gold was hidden in a calfskin and then buried in Saintonge. In Dordogne, there is a reference of a goatskin, from which the expression "golden goat" could be derived. In Corsica, is there not mention of "golden fox" and "golden sheep"? Chthonian or underground archaeology reveals nothing of this kind, not even the humblest treasure. However, one is left with the sense of "buried treasure".

Should one take this in the sense of the fable of La Fontaine, "Le Laboureur et ses enfants", or give it a different interpretation?

This article is intended to bring to light a new interpretation concerned with the making of these structures. The prevailing explanation is that, without exception, they are defensive in character. However, a more detailed investigation forces us to a less categorical conclusion. In fact, the study of the systems of closure and of the contents of the souterrains emphasises not only their functional aspect but also their part in a complex symbolism. It is obvious that the work on souterrains will be based on those from prehistoric times, constructed with deliberate techniques. If the symbolism of the underground is taken into consideration, archaeological study of these structures is likely to become most complex.

Problems of Discovery of the Souterrains

In the Meux and St Maurice-de-Laurancanne region, there are no outcrops of limestone; to reach solid rock one has to dig down at least 50 cm into the arable soil.

The entrances to the souterrains were underground and went into the limestone. They must have been concealed when not in use; today they cannot be detected as they have been filled in. Normal fieldwork does not reveal the original entrances into these underground constructions. However, the use of aerial photography would render discovery easier.

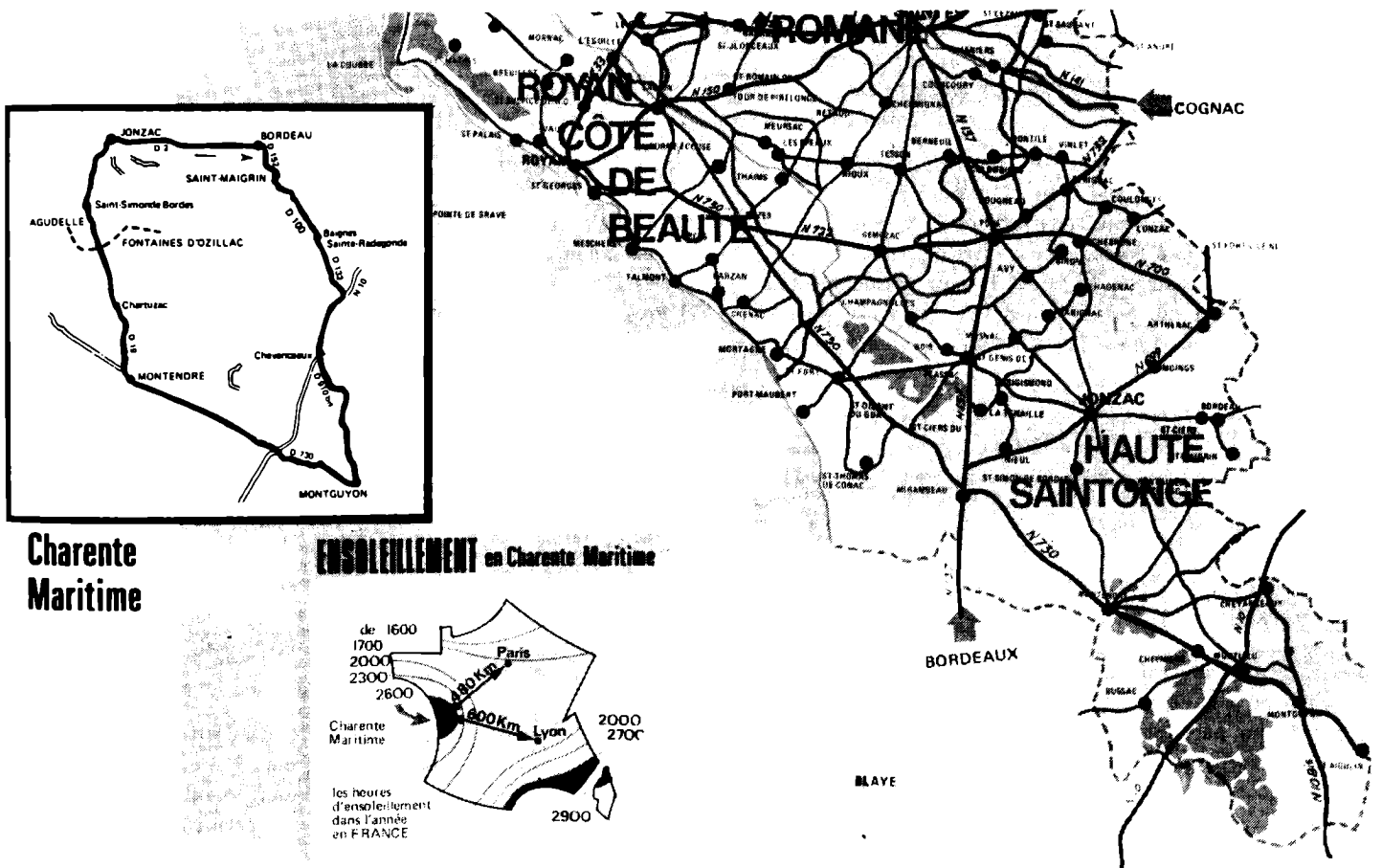
On the other hand, subsidence frequently takes place, making access to the underground chambers possible; most discoveries have come about through this. Subsidence is due to softening of the ground above by rain, so that the vaulting eventually caves in, or the movements of agricultural machinery over the surface cause the collapse of the structure.

It is noticeable that there are often bell-shaped hollows over the vaults, the result of delamination which causes the vault to be more liable to collapse.

Finally, some souterrains are discovered as the result of mechanical digging. To record these souterrains one needs to be lucky enough to be on the spot at the time, since they will be promptly filled in for safety reasons.

Classification of Underground Structures

Among the souterrains a distinction must be made between different types. First there are the karstic galleries, which have been reworked, generally with additional work on roofs and entrances, used either for purposes of fortification or security. Examples of this are seen in the caves of Champagne, Heurtebise and Jonzac. Men have made use of these since the Middle Palaeolithic period, and have continued to do so up to the present day, employing various kinds of building typical of the Middle Ages such as dry-stone walling, heightening of the roof and reworking of the entrances. Secondly, there are souterrains which have been dug in flat regions.



Structures may also be classified according to use: there are burial chambers, works built as hiding-places and refuges, and places in which to store grain and food. Some have been made as secret initiation centres for various pagan cults. In the region under study, this last type is unrepresented.

Study of Closure Systems

The various souterrains found in the south of Saintonge furnish considerable information on the system of closure, listed below:

- Round hole in the wall: diameter 6 cm + 2 cm;
- Square hole in the wall: 7 cm x 7 cm + 2 cm;
- Square hole in floor;
- Groove in wall of vault: 10 cm + 2 cm;
- Comma-shaped closure.

In systems of closure, one can distinguish those which may be functional, such as the round or square holes facing one another, or round or square holes opposite to those of comma shape, and the dry stone walls. Others cannot be

functional, such as types mentioned above which are not set opposite one another, and unilateral arrangements of round or square holes in regular groups of three or four.

It is clear then that many types of holes do not have any obvious practical use therefore it is possible to suggest that they were intended as symbols. Indeed it may be questioned whether some of the so-called functional examples are really so on account of their inefficiency, as in the souterrain "Les Salles". For instance the souterrain "Chez Robin" at St Ciers du Taillan revealed the following: two comma-shaped closures, opposite two square holes, one groove, which could have been functional, and two round holes and five square holes which were isolated, and so could not have been.

There were also two conical holes, 50 cm deep and 10 cm in diameter, dug with a metal bar which must be considered with the niches.

Distribution of closures in the souterrains :

This is shown in the following table:

	Round Hole	Square Hole	Groove	Comma
Saint-Maurice-de-Laurencanne C	0	12	2	1
Saint-Maurice-de-Laurencanne B	7	5	3	0
Saint-Maurice-de-Laurencanne A	4	2	2	2
"Chez Bernier"	12	7	3	0
Totals	23	26	10	3

It suggests certain points of interest, indicating a marked preference for one type of closure in a particular souterrain, as for example square holes in B, while on the other hand there is a homogeneous distribution also found, as in that of the church (A). It is also noticeable that there are a large number of holes (23 round, 26 square) compared to other types (10 grooves, 3 comma-shaped closures).

Examination of Niches and Alcoves

These constructions are found in practically all souterrains. Niches are always in the same form: parallelepipedic or semi-elliptical. Traces of smoke are sometimes found on the walls. Their construction may have been made easier because of the stratification of the rock.

Alcoves are in several categories: they may resemble the beginning of a gallery, or the walls may be corbelled, or they may be parallelepipedic in form, with grooves, or with a platform suggesting a seat. Remains of charcoal are occasionally found on the floor. Two niches or alcoves may face one another in galleries or chambers.

Digging Techniques

Where walls are in good condition, two methods of digging can be made out:

- 1) Progress from one point, when all the pick marks are in the same direction.
- 2) Progress from two distinct points, the pick marks from opposite sides converging at a meeting point.

It is interesting to examine this meeting point: in the souterrains at Boissac, it seems to have been roughly estimated; the traces of digging show no order and there is a difference of level. However, in the shaft at St Maurice-de-Laurencannes, the two ends of the galleries meet perfectly, the tool traces are regular and join in a straight line, and a more highly developed technique appears to have been used.

Two types of tools have been used, one with a plane surface and a variable edge, either 3 cm, 4.5 cm or 6 cm wide; the other was a pick-axe, leaving pointed traces and could be of the type still used by quarrymen with one

extremity pointed and the other with an edge.

Folklore and Interpretation of Evidence

The topography of souterrains in south Saintonge bears some resemblance to symbols reproduced on the floors of our great Gothic churches.

In this connection the church of Fontaines-d'Ozillac, with its symbolism and originality of workmanship, is particularly relevant because this parish is particularly rich in underground constructions; it would be useful to study the church in the village of Aulnay.

The tradition of the labyrinth might in part explain the fear which the local people have of entering these Chthonian constructions.

There is in fact nothing shocking in seeing this approach to study of the unconscious as resembling a Gnostic myth; we are in the region of psychology, in which the roots of Gnosticism are to be found. What is expressed by both Christian and Chthonian symbols is Gnosis (knowledge of spiritual mysteries), and the satisfaction of unconscious needs through symbols has now been recognised in our own day. The creation of myths is a truly original language expressing the psychic process, and no intellectual formula can come anywhere near it in reason and pertinency. From the number of entrances which give access to the souterrain in the region under investigation (from one to three), it is possible to see a connection between the material evidence and the "grand design" behind the work. The plan generally includes three, which correspond with the three porches of Gothic cathedrals dedicated to the Virgin Mother: a single entrance gives access to the central chamber, meeting no obstacle on the way and following a direct route, simple and easy, the "work of the poor"; the second entrance also reaches the centre, but only after a series of detours, and this is the hieroglyph of the long road, "the work of the rich"; while a third gallery ends briefly in a cul-de-sac, a small distance from the threshold.

Moreover, the types of closure, whether functional or not and according to their frequency, should complete the symbolism, expressing the two great difficulties to be encountered: finding access to the interior chamber, and the ability to leave it again. The first of these demands knowledge, while the second indicates change.

The return is achieved with the help of an Ariadne thread, and this is expressed by the symbolism of the lay-out.

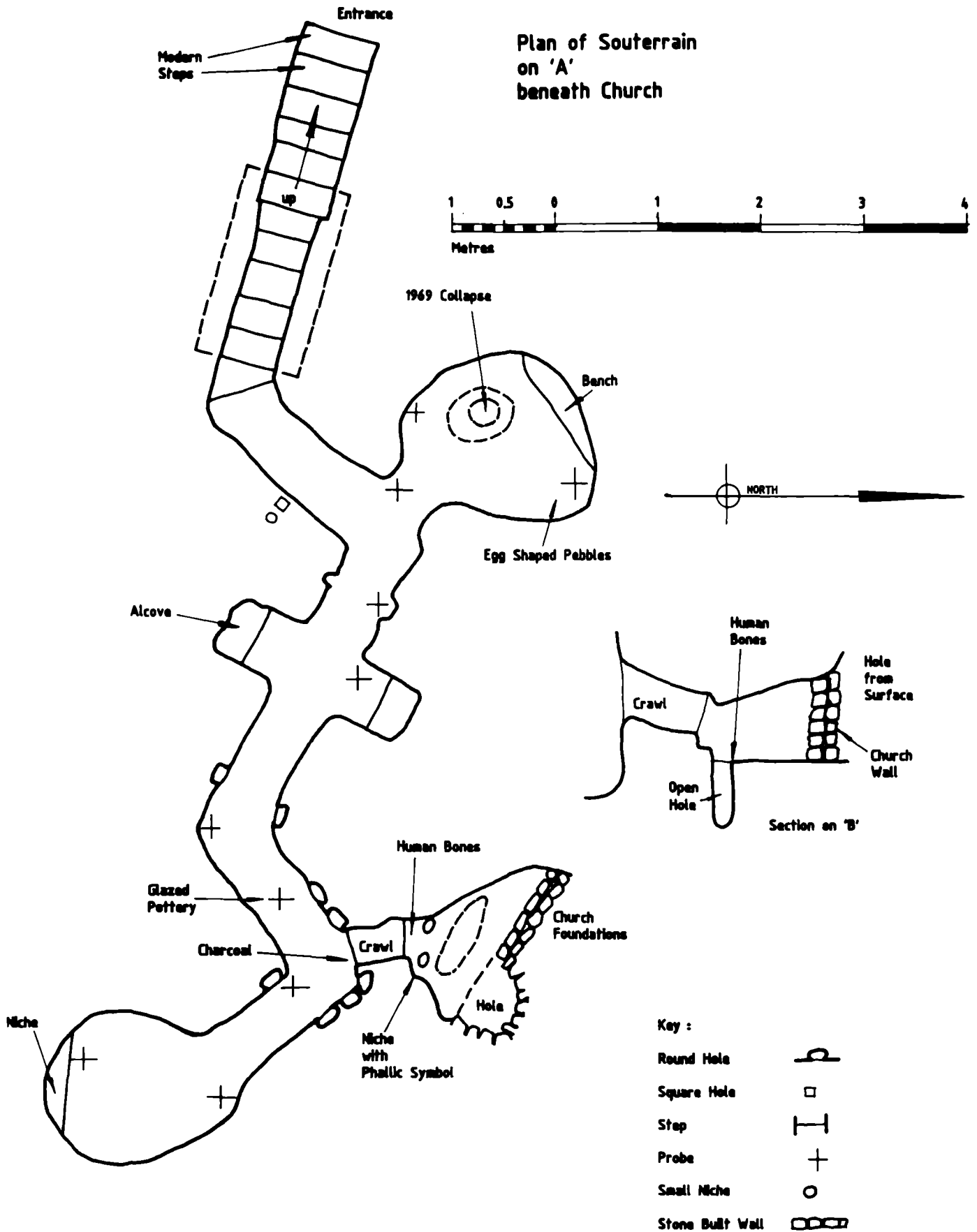
Another belief, common around the district of Saintonge, is worthy of study. It is said that a "Golden Calf" is to be found in every souterrain. Following up this theory, the Golden Calf is the logical conclusion of the labyrinth and the Ariadne thread. We can locate its existence in the centre of the structure and the search for it is one of the keys of the "Magisterium".

Yet another belief found in the region of the souterrains in the village of Chez-Sorignet is that these structures are guarded by "dark angels". We may recall that in a number of Saintonge legends, goblins occupy an important position. These goblins, also called gnomes and dark angels, are very ugly and of small size, but their character is gentle and beneficent and it is very worthwhile to be on good terms with them. The meaning now becomes clear of those legends where the friendship of a goblin opens the way to the riches of the earth. We are dealing here with spirits of the underworld specialising in the guarding of mineral wealth, keeping a constant watch over gold and silver in the mines and the places where precious stones are found. The "dark angels" can by their nature be identified with the "cabiric" elements, the infantile creative forces which are consequently unconscious. To penetrate into a souterrain represented the setting in motion of the struggle between the conscious and the unconscious. The Chthonian structure itself has a dark centre and this characterises the unconscious; light always signifies consciousness. Thus practical features in the form of openings in the roof, "ventilation holes", are a reminder of the existence of the conscious (as in the souterrains of L'Houmade and Chez-Robin). The existence of alcoves and niches and seats facing one another seems to confirm this sense of duality. Each side must correspond with the other like a mirror image, reflected about the central point. This ability to reflect may link up again with the underlying idea of the "Stone" or the "Golden Calf". Also the slopes of the souterrains, expressed in dips and successive descents from one chamber to another, lead down into the depths. Only there can the intense source of life be found. This idea of the depths indicates the natural history of man, his causal link with the world of the instinctive. If this link is not present, or has ceased to exist, he can possess neither "Stone" nor himself.

The unconscious, the greater part of which is beyond comprehension, becomes the symmetrical complement of the conscious with its repressions. Although beyond definition, it is reflected and the conscious is its reflection. The "centre" appears as the point of intersection between the two corresponding worlds, inverted in reflection.

The result of this study in south Saintonge concerned with the cosmic symbolism of the souterrains, shows that these structures in their architecture incline to the symbol of the feminine. The feature of the gully, a narrow passage between two chambers, symbolises the vagina, and to enter it is a spiritual rebirth. The presence of a child's skeleton in a gully at St Maurice-de-Laurencanne is one piece of evidence to confirm this. Other elements, such as the construction of souterrains in wells and direction of water in channels to create an underground washhouse, support this. The feminine symbol of the monument itself is strengthened by the present of masculine symbols within it. A stone phallus is placed in a gully, and there are imported ovoid pebbles, blockage of a vault top by a lance

Commune de Saint Maurice de Laurencanne .17.



shaped stone and spherical stones set in the wall, as well as solar symbols on fragments of pottery. All this can be used as evidence.

Conclusion

First, it is essential to make a systematic inventory to obtain more exact statistics. Then the people of Saint-onge should realise the importance of these souterrains for the better understanding of the culture of their region. A newly discovered souterrain should not be seen as an ordinary hole, in which animal bones, fragments of burnt pottery, as well as nails, keys, shackles and rusted chains are mixed up in confusion and must be thrown away. It would be far better if the pickaxe and shovels were used to put in a concrete slab to shut off the area of subsidence, protect the structure beneath and prevent the fall of animals or other accidents, rather than making use of these tools to smash up the floor of the structure and so close up the souterrain without its "Golden Calf".

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Untranslated notes on the geology of the souterrains can be obtained from the Editor on request.

UNDERGROUND AT COBHAM HALL, KENT

Nesta Caiger

This stately home and its extensive estate, 4 miles SE of Gravesend (TQ 6768), is one of the most interesting National Trust sites to visit in Kent. The house is at present a girls' school and though visitors are not allowed during term time, it is open for viewing for a few weeks during the summer and sometimes at Easter. The Hall was built in the 16th-17th centuries with 18th century alterations.

The house and grounds were extensively altered, restored and beautified during the late 18th and early 19th centuries by the famous architects James Wyatt, the brothers John and George Repton and their father Humphrey Repton, the landscape gardener, who worked on designs for the estate over a period of 25 years.

Amongst the interesting garden buildings with underground features still remaining at Cobham Hall are of course the Mausoleum (designed by Wyatt) an ice-well, a meat store, a 'grotto' and the remains of an 'aviary', part of which was originally hewn out of a ridge of land surrounding the private garden of the 5th Lady Darnley. There is also the 'reservoir' which was part of a complicated water supply system to the house and gardens.

The estate was entirely self-supporting; apart from its large home farm which supplied food for the household, it produced hops on a large scale (and brewed vast amounts of beer in its own brewhouse), it had its own brickworks and a 'coal' mine. Many references to these operations can be found in the Steward's Account Books¹, with sums of money noted and paid to the various employees who worked and lived on the estate.

Probably the most interesting garden building is the Mausoleum. This vast pyramid of Portland Stone was built in 1783 as a monument to the 3rd Earl of Darnley. It is reputed to have cost the sum of £30,000 and took several years to complete. At ground level there was a chapel, originally very richly decorated, and in the basement niches cut to take the coffins. In all there was room for 32 burials around the walls. However, contrary to what Hasted stated in his *History of Kent*², no one was ever laid to rest there.

The ice-well is situated directly behind the 'dairy'. This building is in the form of a mock church and was also designed by Wyatt. Adjacent to it once stood the 'Swiss milking-shed', designed by John Repton. Thus the cows



Entrance to Cobham Hall Mausoleum

were summoned for milking by the 'church' bell in the mock belfry, milked in the shed and the butter and cream were made in the dairy where a plentiful supply of cooling ice was near at hand.

The Meat Store is a chamber which has been excavated into the side of the terrace on the North side of the house. It still has its barrel vaulted roof and its entrance has been embellished with large boulders, reputed to have been

brought in by the 8th Earl of Darnley (who is also supposed to have scattered them around in Cobham Village too). It is doubtful that meat for domestic consumption was ever kept there, but it is possible that food for the animals who were in the 'Menagerie', situated just a short distance away, was stored there. In 1805 there were emus, kangaroos and a leopard in residence and the account books record an allowance for a 'truffle' dog.

Just nearby was the grotto and the aviary which was originally a wooden building let into the side of the hill.

In about 1804 Repton designed a new driveway to the house, also the reservoir, which up until that time had been little more than a large roofed-over pond supplying water to the house and as a source of water in case of fire. This was transformed into an enormous domed tank and the whole covered with a grassy mound. It is entered through a square shaft, and the oval-shaped reservoir itself measures some 30 feet (9 m) by 20 feet (6 m) by 15 feet (4.5 m) high. It is now dry.

All these features are still extant though some are inaccessible due to the state of decay into which they have been allowed to fall. However, the house and gardens are still well worth a visit and one can trace quite easily the remnants of past activities which were once so much a part of life on a large estate.

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UNDERGROUND PHOTOGRAPHY

Nick Catford

Many hundreds of books have been written about photographic techniques since the first photographic image was produced by Joseph Niepce in 1826, and although the use of artificial light has been discussed in very great detail by many eminent authors, the technique of lighting large enclosed areas has been virtually ignored. A small flash gun is quite adequate in the home where a range of a few feet is all that is required, but lighting a passage 100 feet (30 m) in length with a flash mounted on a camera is a virtual impossibility, as the light from the flashgun will only carry a short distance, even at fairly large lens apertures.

Large interiors of buildings can obviously be adequately lit with electric lighting if there is a power source available, but the industrial archaeologist, who is mainly dealing in dereliction, is faced with problems when lighting the interiors of derelict buildings, and even greater

problems when he takes his camera into mines, railway tunnels and various other holes in the ground.

Often, derelict buildings are partially lit by daylight streaming through windows and holes in roofs, and the use of a sturdy tripod should allow a long exposure without the need for any additional artificial lighting. In this sort of situation any windows or other areas open directly to daylight will be grossly overexposed which can be partially compensated for at the printing stage, assuming that prints are the end result. It may be possible to decrease the exposure time by lighting the darker corners with electronic flash. So long as the exposure is fairly long the camera will not see a speedily moving photographer in front of the lens dashing from one concealed point to another to fire the flash gun.

When calculating long exposures the photographer must take

note of "reciprocity law failure" which is the failure of the reciprocal relationship between time and intensity in affecting exposure. This means that when exposing at very slow speeds (longer than one second) the exposure time, as indicated by an exposure meter, will have to be increased. For example, if the indicated exposure is 8 seconds, the correct exposure would be 16 seconds (or a 1-stop increase in the aperture). If, however, the indicated exposure is as long as 10 minutes, which is not unknown in many semi-subterranean sites, the correct exposure would be 68 minutes and 22 seconds. Exposure can be corrected without any problem with black and white film, assuming the appropriate tables are carried. Colour film is made of three different emulsion layers and each layer is affected to a different degree, so correction is virtually impossible.

In most underground situations, no light source is available apart from that carried by the photographer. In the first instance, consideration should be given as to the best equipment to use. It is possible to take photographs underground with an ordinary domestic camera with its own built-in flash, but this sort of equipment is unlikely to give good results. It is preferable for the flash to be detached from the camera, to allow the gun to be fired more than once. A tripod will have to be used to ensure the camera is in the same position each time the flash is fired. A very sturdy tripod is desirable, but not so bulky that it is difficult to transport underground.

Secondly, attention must be applied to the type of camera. Polaroids and small format cameras (disc or 110) are not suitable but any 35mm camera with a B or T setting on the shutter (to allow time exposures) should do. 35mm is obviously preferable for slides but for prints a larger format is more suitable as this allows a higher quality of enlargement. It is virtually impossible to keep a camera clean underground so something that is well built and rugged is advantageous.

Thirdly, consider the lens. A wide angle lens will give a large angle of view and is useful in a narrow passage, but in a large cavern the greater coverage will require more light so a standard lens is perfectly acceptable. Telephoto lenses are not usually of much use underground.

The choice between slides and prints is a personal one, but it must be remembered that the exposure for slides is far more critical than for negatives. For slides, half a stop either side of the correct exposure is all that is acceptable, while with negative film a couple of stops out will probably still produce acceptable prints. As underground photography relies on a certain amount of luck and guesswork as far as lighting is concerned, success is more likely to be achieved with prints, especially if hand printing is available as the operator has control over the enlargement. The main disadvantage of hand printing is that it is considerably more expensive than machine printing that is available from chemists and postal laboratories. If slides are required it may be preferable to make slides from prints. When photographing fairly narrow

passages a medium speed film is advisable (100 ASA) to avoid over-exposing the foreground and to allow very even illuminations. Large caverns will often require higher speed films.

When prints are to be produced it is useful to place something of known colour in the picture to allow accurate colours to be achieved at the printing stage. A Kodak standard grey card is most suitable.

The most important equipment underground is the lighting. Flash powder is still occasionally used but it is difficult to obtain and difficult to control so the choice is between flash bulbs and electronic flash. Flash bulbs come in many sizes, and generally give out more light than electronic flash. The main disadvantage of bulbs is that they can only be used once and are therefore quite expensive. PF60s (or equivalent) are the largest bulbs still available today and at £1 per bulb it is not very economical when 10 or 12 bulbs may be needed for one shot. They do, however, give out a lot of light. Smaller bulbs, such as the more easily available PF1, give out no more light than a small electric flash unit and are therefore not really worth considering.

A medium sized portable flash unit with detachable head (such as the Mecablitz 402) is the most suitable form of light source but it may be necessary to supplement the internal batteries if a large number of photographs are to be taken in one session. A large Ni-Cad pack or a sealed lead acid battery is suitable.

Having assembled all the appropriate equipment, the next step is to learn the technique of "picture building". As an example, a long narrow passage with no places to hide a flashgun has to be photographed.

Using an aperture of f16 and the flash at the camera position (Figure 1), only a small area in front of the camera will be illuminated. A larger aperture would allow the flash to carry a lot further but would lead to over-exposure in the foreground, especially in a narrow passage, and would give a limited depth of field (the distance between the nearest and furthest points that are in focus). As it is not advisable to increase the size of the aperture the only way to illuminate further down the passage is to fire the flash from a point some feet in front of the camera. If this was the sole source of illumination (e.g. 6 feet (2 m) in front of the camera), the light would travel further down the passage but the area immediately in front of the camera would receive no light (Figure 2) and a silhouette of the person holding the flashgun would be clearly visible.

If the passage is lit from two points, the camera position and from some feet in front (Figure 3), the passage will be illuminated for twice the distance achieved from the camera position alone. If the flash positions are carefully plotted, it should be possible to eliminate the silhouette of the person holding the flashgun in front of

Figures 1-5



Fig 1. Flash at camera

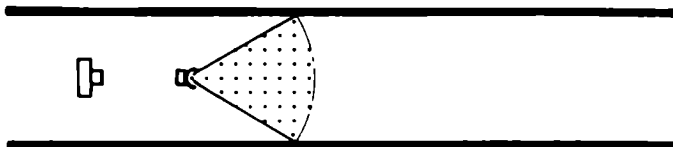


Fig 2. Flash in front of camera



Fig 3. Flash in front of and at camera

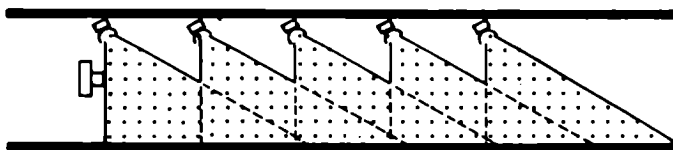


Fig 4. Flash at 7'0" intervals along one wall

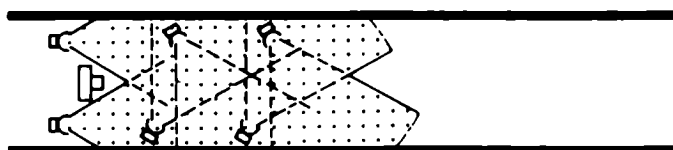


Fig 5. Flash at 7'0" intervals along both walls

the camera. Why doesn't the camera see the person holding the flashgun? As already mentioned, the person holding the flashgun would only appear as a silhouette as the light from the gun is directed forwards (away from the camera). As a silhouette is an area that has received no light, if that area is then lit (i.e. from the camera position) the silhouette should then disappear and there should be an uninterrupted view of the passage.

It should be possible to walk along one wall firing the flash at 6-8 foot (2-2.5 m) intervals (Figure 4). The flash should always be aimed forwards at an angle of 45° to the wall. This should evenly illuminate the opposite wall but will leave a row of silhouettes along the unlit side. To remove these, and light the opposite wall a staggered set of flashes should be fired along the other side as well (Figure 5). The end result, if the flash positions are carefully plotted, should be an evenly illuminated passage lit to the furthest point that the film can usefully resolve.

In most practical circumstances the accurate positioning of the flash would take so long that it is acceptable to leave the actual positions to guesswork and luck. It is useful to leave some kind of light close to and behind the camera, to give an indication of where the camera is located. This is useful when the passage bends, to save lighting a section of passage that the camera can't 'see'. Moving from one flash position to another it is useful to employ a helper to cover the lens while you move about with the aid of a torch. Once the lens is uncovered all lights in front of the camera should be extinguished.

This method of lighting will work well in a relatively narrow passage (up to 10 feet (3 m) wide). In wider passages or chambers, it may be necessary to have another two lines of flash positions either side of the passage centre line (Figure 6). In this situation careful flash positioning is even more critical to ensure even illumination. Also, if a passage is more than 8 feet (2.5 m) high each flash position should have one flash angled forwards and another angled upwards. This method of lighting was employed in this view of a disused stone quarry at Bradford-on-Avon (the scale is 24 inches (0.73 m) long).

In many circumstances the flash can be fired from concealed positions (that cannot be seen by the camera) (Figure 7) e.g. behind pillars, round corners, up side passages etc. It is, however, unlikely that there will be sufficient concealed positions to allow complete and even illumination, so that it is more usual to build a picture up with the flash located in exposed and concealed positions (Figure 8).

In large chambers, this method of multiple flash lighting is more difficult to achieve. Some of the North Wales slate mines, for example, have chambers that are several hundred feet high. In this sort of situation the use of medium speed film and a small aperture is out of the question. The only answer is to use high speed film and a

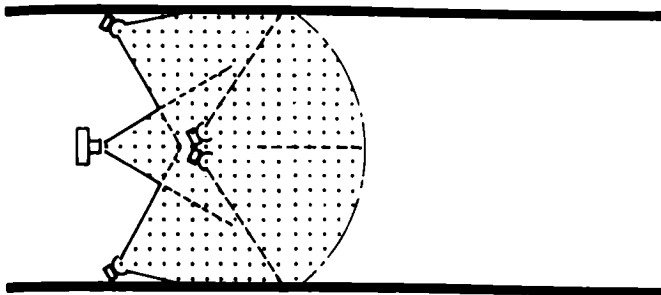


Fig 6. Flash along walls and centre of a wide passage

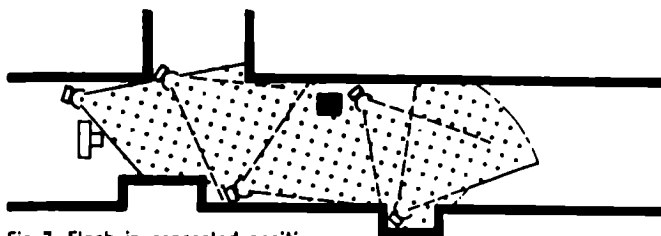


Fig 7. Flash in concealed positions

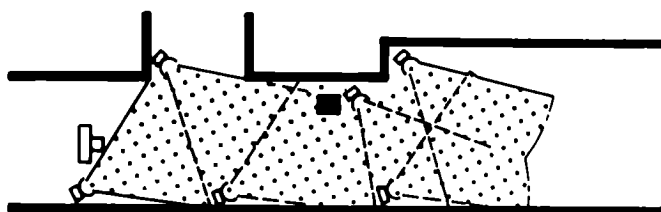


Fig 8. Flash in open and concealed positions



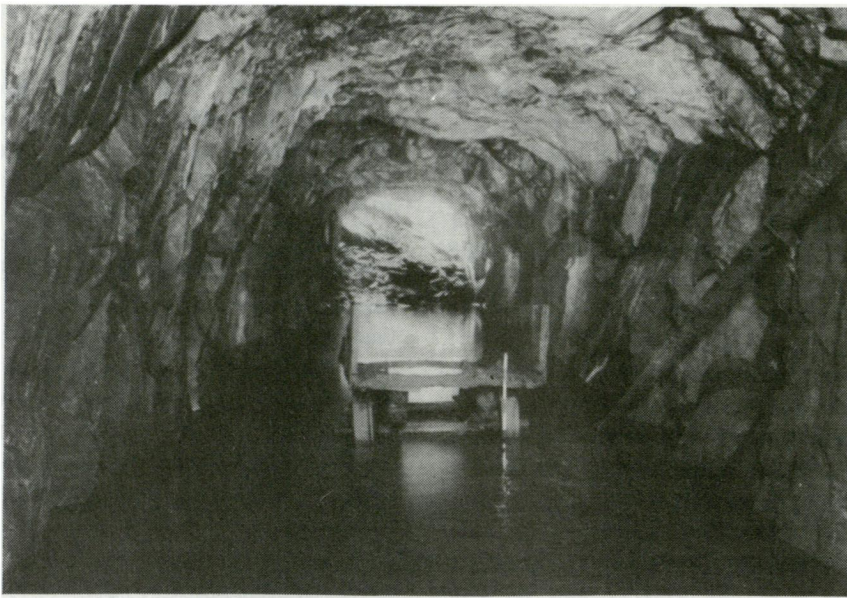
Fig 9. Side lighting

large aperture. Colour film is available up to 1600 ASA and black and white film can be uprated as high as 6400 ASA, which means that far less light is required to achieve an exposure. Unfortunately, under these conditions, the picture quality will suffer. High speed films are always a lot more "grainy", which gives a lack of sharpness. Lenses also suffer from edge distortion at large apertures as well as giving a small depth of field (which might not matter in such large areas). The fact that the lighting must come from one level (the camera level), means that the foreground will receive a lot of light, and the background not enough. Not a very satisfactory situation but it should be possible to achieve an acceptable image, assuming that negative film is being used.

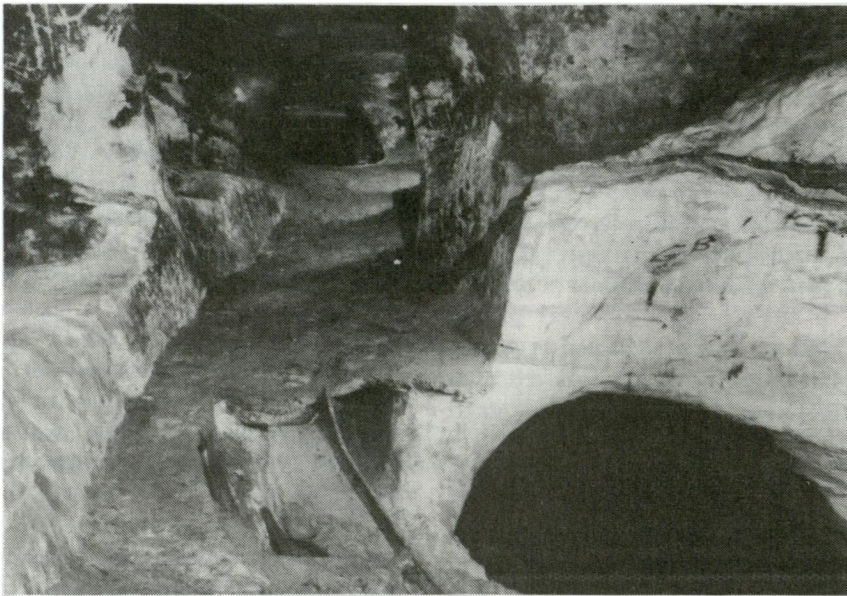
Some subterranean passages are very small, and this presents another problem. A person in a small tunnel firing a flash gun would obviously fill the tunnel so that no light from the flash would be able to get past and reach the lens. It may be possible to set up a line of remotely controlled flash guns along the lines already described. An alternative method of lighting called "painting with light" could be employed. For this technique a powerful torch with a narrow beam is required. With the shutter open the torch beam should be directed along the passage, continually keeping the beam on the move. To a certain extent this method of lighting involves a lot of trial and error, but with practice it should be possible to evenly illuminate a fairly long passage of very small dimensions. One of the main disadvantages of using a torch is the fact that the colour temperature of the torch is unlikely to match up with any currently available film, so this method of lighting is therefore only suitable for use with black and white film.

Sometimes it is necessary to photograph footprints, tool marks, carved inscriptions etc. A single flash from the camera position might seem the obvious answer as the distances involved aren't likely to be very great. However, the results achieved by this method of lighting can be very disappointing. What is required is a method of lighting that will emphasise the tool marks, footprints etc., and make them stand out. A tool mark will leave a slightly raised surface. By placing a light or flash gun at an acute angle to the wall it should be possible to emphasise these marks by the shadows that are cast. In practice, it is usually advisable to include some frontal lighting (Figure 9) so that the shadows are not too harsh that they obscure some of the detail. This "texture" lighting is often employed when photographing buildings where a more striking photograph can be achieved by having a low sun at one side of the building rather than behind the camera.

In conclusion, it is useful to remember that dark walls absorb light and therefore need more of it, and light walls reflect light and therefore need less of it.



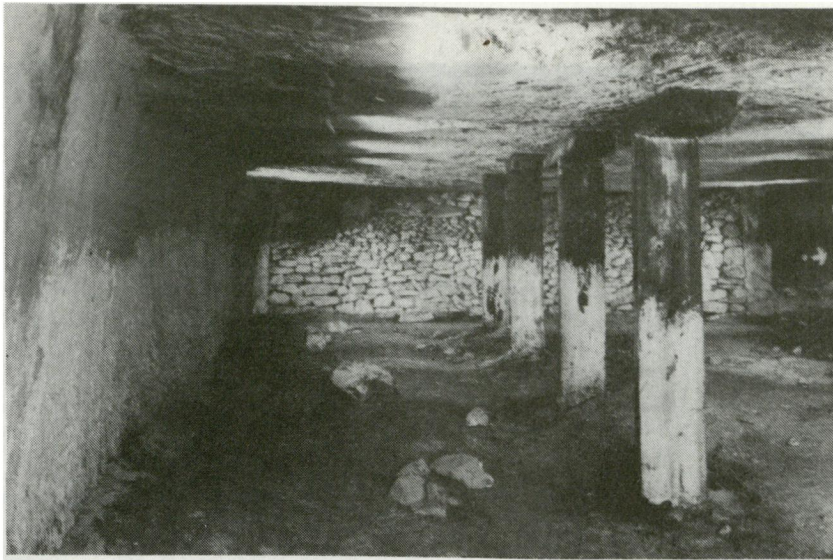
Photograph 1 Minllyn Slate Quarry adit (Gwynedd) lit by a combination of electronic flash and daylight



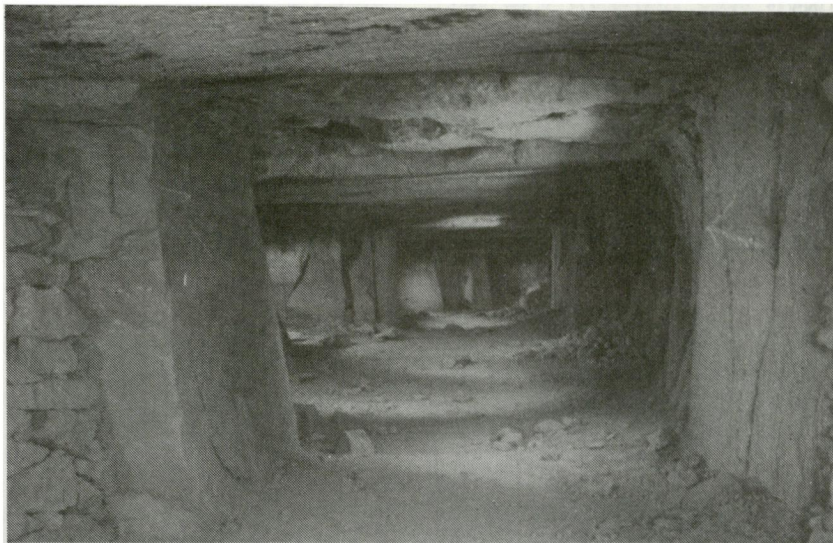
Photograph 2 Disused sand mine (filled 1987) at Reigate (Surrey) lit by a combination of exposed and concealed flash positions - taken at the East Surrey Study Weekend, 1981



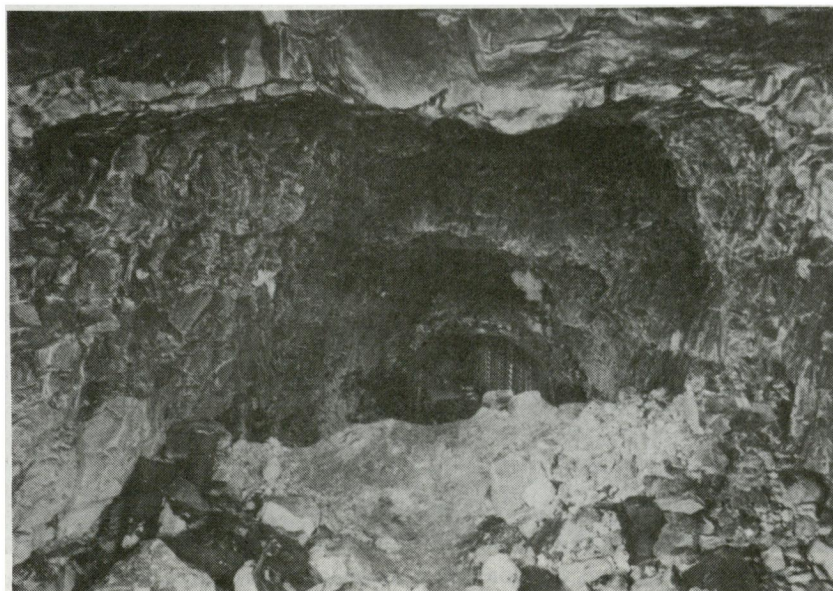
Photograph 3 One of the disused levels at Snailbeach Lead Mine in Shropshire lit by electronic flash in exposed positions - taken at the Ironbridge Gorge Study Weekend, 1985



Photograph 4 Godstone Hill Hearthstone Mine in Surrey; the pit props are just wide enough to conceal a man with a
flash gun



Photograph 5 Rockshaw building stone quarry (Surrey) photographed using a combination of exposed and concealed (behind the pillars) flash positions



Photograph 6 World War 2 battery tunnels at Dover (Kent) - taken at the East Kent Study Weekend, 1984



Photograph 7 The 'Tar Tunnel', Coalport, Shropshire, lit from exposed flash positions - taken at the Ironbridge Gorge Study Weekend, 1985



Photograph 8 Disused underground radar station at Wartling (Kent) lit entirely from hidden flash positions



Photograph 9 Disused Wood Lane Underground Station (W London) lit partially by existing tungsten light and, in the foreground, by electronic flash

All the photographs have been taken by the author, Nick Catford

MINING HISTORY COMPUTERISED

Paul W. Sowan

Often the beginner in mining history finds great difficulty tracing any more than the most scant information relating to mine sites, of whatever period. Beyond the obvious geological and local-history publications, however, the determined searcher ultimately reaches the point where he can think of any number of records, depositories and sources to ransack whenever he can find the time during official opening hours (all too restricted) of libraries, record offices, etc.

In two current examples, such quantities of numerical and other data survive that computerisation has been resorted to in order to facilitate quantitative and historical study. Dr Roger Burt of University of Exeter has put onto computer the UK Mining Records Office's (and its successors') Mineral Statistics, thus allowing print-outs county by county, and mine by mine (and no doubt analyses by

product, company, etc, as well) which contain much data for British mines during the last three quarters of the 19th century. The mining statistics for Derbyshire have now been published (separately reported), and it is understood that volumes for other counties will follow.

Jeremy Greenwood, of Reigate, is busily putting data onto computer concerning all consignments of firestone from the underground quarries in Surrey, from mediaeval building accounts. He is already able to demonstrate that the output of these quarries was, at times, of the order of over 1,000 tons per annum. Whether this quantitative study of stone output will reveal fluctuations bearing any relationship to the importing of Surrey firestone's main competitor as a freestone, Caen stone from Normandy, or to political relationships with that part of France, remains to be seen.

MINING HISTORY PUBLICATIONS

Paul W. Sowan

Although published from Sheffield, by the Northern Mine Research Society, the journal *British Mining* contains from time to time papers relating to all parts of the British Isles, and is perhaps the closest we have in Britain to a true national journal of mining history. Its most recent issue, no 19, being the Memoirs of the Society for 1980-82, published in May this year, illustrates some of the problems which remain to be overcome if standards of mining history publications are to be raised generally and if *British Mining* is to satisfactorily fill the role of a national journal.

Pages 58-90 are devoted to an article 'submitted' by a J. Keating entitled *Merstham Firestone Quarries: an Interim Report*, including some 17 sketch maps and mine surveys and the like, and two pages of an at-first-glance impressive bibliography which starts with an Act of Parliament 27 Eliz. 1, 1585, and continues to a 1938 Publication of the Wren Society concerning the building accounts of St Paul's Cathedral. Regrettably, the article as published is an almost exact reprint, without acknowledgment, of a 30-page booklet published by Croydon Caving Club in 1976 which summarised the Club's and others' fieldwork until that date, and such published documentary researches as were then available. Even more regrettably, the legend 'Survey by Croydon Caving Club' which appeared on many of the mine surveys in the original publication has been changed to 'Survey by Mine Exploration Unit', although the composition or terms of reference of this 'Unit' are nowhere given. Dates of surveys have been deleted, too.

Three figures have been omitted. One has been redrawn in such a way that it now refers to a Quarry Banfield, instead of Quarry Bamfield in the original booklet, which is itself a much-copied transcription error for Quarry Barn Field in the primary source - an early 19th century estate map. Also omitted are the entire contents of page 27 in the original document, including the last two sentences relating to the Quarry Hangers site, and six lines of acknowledgments which Croydon Caving Club very properly included but which Keating appears to think superfluous!

Croydon Caving Club's booklet itself has its imperfections, although it is a most useful summary and record of field investigations undertaken by its members and others. It is often the case that 'practical' cavers and students of mining industrial archaeology (IA) can and do make exceptionally valuable observations and surveys, above and below ground, but are not well versed in the altogether different skills of documentary research or assessment of primary or secondary sources, or historical reconstruction. The Croydon booklet, for example, derived its bibliography from (duly acknowledged) earlier publications, although it is quite clear that its authors had not consulted many of the items cited, as they have no relevance whatsoever to the restricted part of the Surrey mines scene under consideration! One entry, on the other hand, does contain a puzzling mention of the Merstham mines which can now be satisfactorily re-interpreted, although this is not mentioned in the text.

Both *Subterranea Britannica* and the National Association of Mining History Organisations (NAMHO) have amongst their aims the improvement of standards in researching underground structures, and in publication of such researches. Editors should beware of 'out-district' contributions, and of papers purporting to report from both IA and historical angles - few active workers are able to master both approaches. Now that we have SB and NAMHO, and mining history conferences and seminars up and down the country where active researchers can meet and discuss mutual interests and problems, it is to be hoped that unfortunate usage of valuable publishing space such as exemplified by Keating's 'contribution', can be avoided, and editors can more easily identify and contact suitable referees for all contributions purporting to be serious contributions to original knowledge. Thirty or so pages of *British Mining* could so easily and usefully have been devoted to an up-to-date and authoritative review of Surrey's place in the history of underground

stone-quarrying, or to the important advances in field investigation and documentary researches concerning the Merstham quarries, or indeed to anything more valuable than a plagiarised six-year-old publication!

A further example of out-district publishing of doubtful value, also concerning Surrey sites, was provided last year by the *Journal of the Plymouth Mining Club* 11(3), where we find an extraordinarily inaccurate and out-of-date account of "Hearthstone Mines of North-East Surrey" that would not even be of much use to a vaguely interested visitor from Devon as surface conditions and access details have in many cases changed radically. And we are all becoming increasingly aware of the problems of unlimited access, encouraged by indiscriminate publication of entrance details, can bring; this can undo all the good work of local groups who have established agreed procedures with land owners and local authorities.

ERRATA - SUBTERRANEA BRITANNICA BULLETIN No 23

A Complex of Tunnels at Langton Priory, Guildford
by R. Williams

Page 1 line 1: insert "of a mile" after "three quarters"
line 10: "rebuilt" to read "built"

Page 1 3rd paragraph, line 10: delete "the foreground" and replace by "this tunnel (see second photograph)"
Lines 16, 17, 18: delete "and the... steps"

Page 1 5th paragraph, line 4: replace "(fig 5)" by "(first photograph)"

Page 1 8th paragraph, line 5: delete "(fig 6)"

Page 5 Note:, line 7: "Cooke" to read "Corke"

The plan of the tunnel complex was based on the survey by J.B. Henderson and H. Pearman and first appeared in *Chelsea Speleological Society Records*, volume 14 in 1984 together with a detailed description of the site. With apologies to those concerned.

Front Cover: World War 2 battery tunnels at St Margaret's Bay (Kent) lit entirely by electronic flash in exposed positions. (See article by Nick Catford on *Underground Photography*, in this issue).

